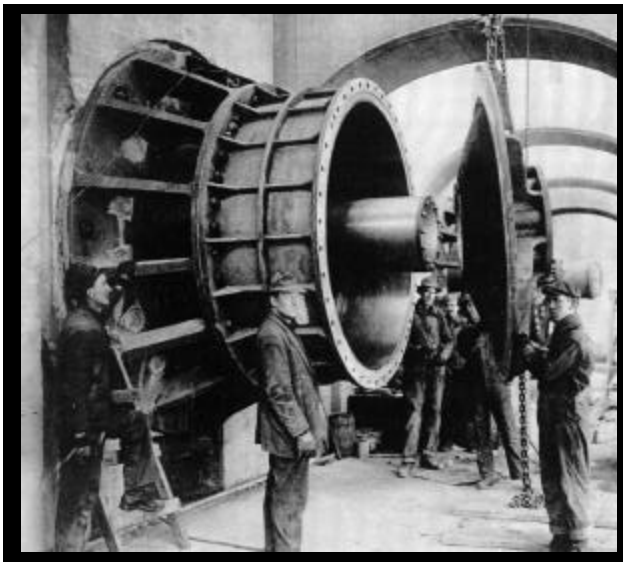

Arrowrock Dam
Outlet Works
Rehabilitation

Final Environmental Impact Statement

U.S. Bureau of Reclamation
Pacific Northwest Region
Snake River Area Office
Boise, Idaho

March 2001

Draft Environmental Impact Statement
Arrowrock Dam Outlet Works Rehabilitation

Prepared by: Bureau of Reclamation
Pacific Northwest Region
Snake River Area Office
Boise Idaho

Abstract:

The Bureau of Reclamation proposes to rehabilitate the Arrowrock Dam outlet works by removing the 10 lower level Ensign valves and replacing those valves with 10 clamshell gates. The 10 upper level conduits controlled by Ensign valves and the 5 sluice outlets controlled by slide gates would be abandoned but left in place. Rehabilitation would require three construction seasons in a 4-year period and operational changes of the Boise River/reservoir system. Two alternatives have been identified that differ only in the timing of reservoir drawdown and the elevation of Arrowrock Reservoir and Lucky Peak Lake in the third construction season. During the first two construction seasons Arrowrock Reservoir would be held at a fairly high level and Lucky Peak Lake would be held at low level (both within normal operating levels). In the third construction season, Arrowrock Reservoir would be drawn down to a very low level for 5 months in the fall and winter (Preferred Alternative) or to near run-of-river for 9 weeks. These low levels would be comparable with extreme drought conditions and levels required in the past for maintenance of the lower Ensign valves. Lucky Peak Lake, which at full pool elevations rises about 100 feet above the toe of Arrowrock Dam would be held at a low level (within normal operating levels) during this construction season. Although the Lucky Peak Lake elevation would be within normal operating ranges, it would be low for a longer period than normal. This EIS has been developed to comply with the requirements of the National Environmental Policy Act. It also provides the public review required under Executive Order 11988 (Floodplain Management) and Executive Order 11990 (Protection of Wetlands)

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Comments Must Be Received by: January 5, 2001

Boise River Basin
Location

Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
BA	Biological Assessment
BO	Biological Opinion
BPA	Bonneville Power Administration
BPBOC	Boise Project Board of Control
℄	Center line
CAR	Coordination Act Report (Fish and Wildlife)
CEQ	Council on Environmental Quality
CFR	Codified Federal Regulations
cfs	cubic feet per second
Corps	United States Army Corps of Engineers
CWA	Clean Water Act
DEIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FWCA	Fish and Wildlife Coordination Act
HAER	Historic American Engineering Record
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IDPR	Idaho Department of Parks and Recreation
IDWR	Idaho Department of Water Resources
ITA	Indian Trust Asset
kW	kilowatt
kWh	kilowatt-hour
mg/L	milligrams per liter
M&I	Municipal and Industrial
MODSIM	Model Simulation (a computer program)
MW	megawatt
MWh	megawatt-hour
NAGPRA	Native American Graves Protection and Repatriation Act
NED	National Economic Development
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
OM&R	Operations, Maintenance, and Replacement
OHV	Off-highway vehicle
Reclamation	Bureau of Reclamation
RPM	Reasonable and prudent measure
SHPO	State Historical Preservation Office (or Officer)
SRAO	Snake River Area Office (Bureau of Reclamation)
SOP	Standing operating procedures

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SUMMARY

SUMMARY

Purpose and Scope

Arrowrock Dam, completed in 1915, was constructed by the Bureau of Reclamation (Reclamation) as part of the Boise Project in southwest Idaho. The dam is located on the main stem Boise River about 17 river miles upstream from the city of Boise. Arrowrock Reservoir is operated as one of three storage facilities constructed on the Boise River. Anderson Ranch Dam and Reservoir, located on the South Fork Boise River and generally east of Arrowrock Dam, were completed by Reclamation in 1950 as part of the Boise Project. Lucky Peak Dam and Lake, located to the southwest and about 11 river miles downstream of Arrowrock Dam, were completed by the U.S. Army Corps of Engineers (Corps) in 1957. Reclamation and the Corps operate the three storage dams in a coordinated manner for irrigation water supply (Reclamation markets the water supply in Lucky Peak Lake for irrigation), flood control, recreation, and fish and wildlife.

The purpose of the proposed action is to enable Reclamation to continue to operate Arrowrock Dam and Reservoir to meet the project purposes of irrigation and flood control.

Alternative A is identified as the preferred and environmentally preferred alternative, in accordance with 40 Code of Federal Regulations (CFR) 1502.14(e) and *Departmental Manual* Part 516, Chapter 4, 4.10A.

This Final Environmental Impact Statement focuses on the potential effects of the No Action Alternative and two construction alternatives for replacing the lower row of Ensign valves with clamshell gates. The No Action Alternative consists of an aggressive maintenance program that would be implemented if the valves are not replaced.

Reclamation's scoping process included numerous meetings with Idaho State and Federal agencies, Indian Tribes, local groups, and interested individuals. Notices of intent to prepare an Environmental Impact Statement and to hold a public scoping meeting were published and a public scoping meeting was held on November 20, 1998. The results of meetings and comments have been considered in the development of the No Action and action alternatives.

Environmental effects of the No Action and action alternatives were analyzed for the stream reaches and reservoirs upstream and downstream from Arrowrock Dam and Reservoir. Environmental effects are generally limited to those associated with construction and the reservoir drawdowns necessary for maintenance and replacement of the lower outlets.

A Draft EIS, issued on October 23, 2000, provided the opportunity for public review and comment for a period of 60 days. Sixteen letters of comments were received. Main areas of concern were economics, safety, dissemination of information/status updates, repayment, water quality, fish, and recreation impacts. The text of this EIS has been revised as appropriate. The most significant change is the criteria for use of sluice gates in Alternative A. To mitigate for water quality, this change allows the work site to be flooded 5 days cumulatively before the

sluice gates are opened. As a result, the probability of using the sluice gates would be only 15 percent under Alternative A.

Need for Action

The current condition of the Arrowrock Dam outlet works presents an increasingly difficult maintenance problem. The Ensign valves, which control water releases from the dam, have been in use since 1915 and have exceeded their design life. Most of the Ensign valves have been damaged through prolonged use. Three valves that control flow through the middle row of conduits (lower row of Ensign valves) are currently out of service. The gates that control the sluice outlets, which are needed to empty the reservoir for inspection and maintenance of the lower level Ensign valves, are also damaged. Use of two of the five sluice gates is currently limited. Based on the results of the last inspection, major repairs and rehabilitation of the existing valves and sluice gates are needed to assure continued use over the long term.

Maintenance procedures, which call for inspection and repair of the lower row of Ensign valves every 6 years, require that Arrowrock Reservoir be drawn down to a very low level. Drawdown for inspection and repair is a problem because the sluice gates, which must be operated to lower the reservoir level, also need repair. There are also environmental concerns associated with the drawdown of the reservoir and use of the sluice gates. Use of the sluice gates causes turbidity downstream and sediment deposition in Lucky Peak Lake. Extreme drawdowns and use of the sluice gates for inspection and maintenance adversely affect bull trout, other fish, and water quality. Due to these concerns, and in anticipation of a long-term solution to the maintenance problem, Reclamation has deferred inspection and maintenance of the lower Ensign valves since 1988.

The condition of the lower Ensign valves inhibits Reclamation's ability to release sufficient flow to meet project purposes under some conditions. Due to susceptibility to damage, the lower row of Ensign valves cannot be used under high pressure conditions, e.g., when the reservoir is nearly full. In years with high runoff, this operational constraint reduces the ability to release water for flood control operations.

Restricted flow capacity is also a problem in drought years. This occurs when there is a low head differential between Arrowrock and Lucky Peak. Under that condition it is not possible to pass adequate flows through Arrowrock Dam while maintaining the Lucky Peak Lake **elevation** for recreation. When Arrowrock Reservoir is at a target conservation pool elevation of 3078 and Lucky Peak is at a full pool of 3055, the seven operational valves can only pass 2,900 cfs. That contrasts with an irrigation demand of about 4,300 cfs. The proposed clamshell gates will allow a release of about 5,000 cfs in this scenario.

Because of the condition and age of the valves it is possible that some of the lower valves could malfunction and stick in either the open or closed position, requiring unplanned reservoir drawdown to repair the valves. Valves stuck in either position would reduce flood control flexibility and could result in some increased downstream flooding. Stuck valves during the irrigation season could also affect irrigation water deliveries.

Alternatives

Two action alternatives have been identified to resolve problems associated with the Ensign valves. Facilities included in these two alternatives are identical, both require three construction seasons, and only the operation of reservoirs during the third year of the construction period differ. Alternative A features an Arrowrock Reservoir elevation greater than the No Action, with only a 15 percent chance of using the sluice gates to maintain reservoir elevation. In contrast, Alternative B features a much shorter reservoir drawdown than the No Action Alternative, but a lower reservoir elevation than Alternative A. Alternative A is Reclamation's Preferred Alternative.

Both action alternatives consist of replacing the 10 lower Ensign valves located on the upstream side of the dam with clamshell gates to be located on the downstream side of the dam. Associated structures and features include a control house and new gallery entrance for access to the clamshell gates, steel conduit liners, modified trashracks to accept a bulkhead gate for maintenance of the outlets, and a bubbler system to maintain an ice-free area of water around the guides of the bulkhead gate. Steel liners would be grouted in place. Bellmouths would be mounted on the upstream face of the dam in place of the Ensign valves and welded to the liners. Construction would require 3 years and a drawdown of Arrowrock Reservoir below normal operating levels in the third year to accommodate construction on the upstream face of the dam.

The top row of Ensign valves and the sluice gates would be abandoned. One or two of the Ensign valves removed from the lower row would be retained for subsequent use as an interpretive exhibit at a Reclamation facility.

No Action Alternative

The No Action Alternative is defined as "the most likely future without the proposed action" and is the baseline for evaluating the effects of the action alternatives. For this analysis, the No Action Alternative is not the status quo operation scenario of the past 10 years. Although the Standing Operating Procedures for Arrowrock Dam state that the Ensign valves are to be inspected every 6 years and repaired as necessary, maintenance on the lower outlets has been deferred since 1988 pending a resolution of maintenance and valve replacement options. Maintenance of the sluice gates has also been deferred since 1988. The No Action Alternative would consist of an aggressive maintenance program for the lower row of Ensign valves and the sluice gates.

The No Action Alternative consists of inspection and minor cavitation repair from November 1 through December 31 during the first maintenance season (Arrowrock Reservoir would be at elevation 3007 feet). See figure S-1 for a cross section of Arrowrock Dam and the reservoir elevations during the maintenance season. After the initial inspection and minor repair in the first maintenance season three or four Ensign valves would be completely overhauled and the remaining valves would be inspected and minor repairs made at each subsequent maintenance drawdown. At the next maintenance drawdown (2 years after the first maintenance drawdown), Arrowrock Reservoir would be drafted to elevation 2975 feet from October 1 through February 28. Every sixth year for the life of the project, there would be a maintenance drawdown

extending from October 1 through February 28. Reservoir elevations during maintenance drawdowns would alternately be at 3007 feet and 2975 feet. The sluice gates would be inspected and two or three sluice gates would be overhauled or repaired as necessary during maintenance drawdowns to elevation 2975 feet.

The No Action Alternative would assure that every lower Ensign valves is overhauled once every 18 years and that sluice gates are inspected and repaired as necessary once every 12 years.

Maintenance activities related to the upper row of Ensign valves would continue as in the past and are included in the cost of the No Action Alternative. However, no description is included here because reservoir drawdowns lower than normal operation are not needed for work on the upper valves.

A 50-year life cycle cost analysis was made for the No Action Alternative. Capital costs are estimated at $34,300,000. This includes all of the costs for periodic inspection and repair of the outlet facilities until all are fully operational. The present worth value for comparison with the action alternatives is $11,000,000.

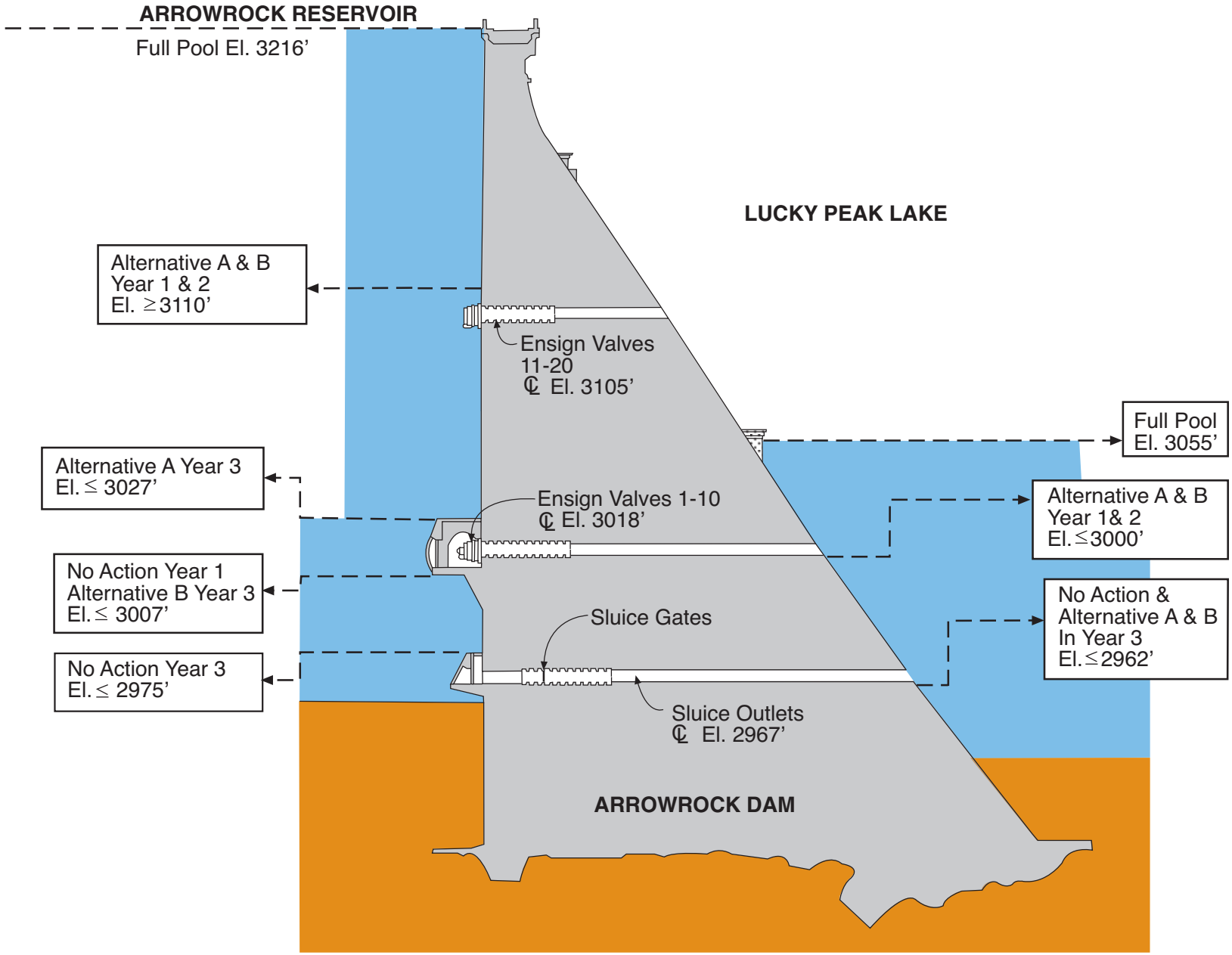
Accumulated annual operation, maintenance, and replacement costs are estimated at $1,000,000 over a 50 year-period and are based on the costs of periodic inspection and repair as necessary after the facilities are made fully functional. From an economic viewpoint it becomes problematic to separate operating and capital replacement costs to maintain and repair machinery that is very old. In addition there is some risk that eventually the required pieces and parts may not be found or may not be remanufactured at reasonable prices.

Alternative A (Preferred Alternative)– Replace Lower Row of Ensign Valves with Clamshell Gates, Arrowrock Reservoir Elevation 3027 Feet in Construction Season 3

Alternative A consists of three construction seasons and provides the largest possible pool for Arrowrock Reservoir (1,500 acre-feet) in the third season while still allowing valve replacement in a dry condition (see figure S-1). During the first two construction seasons, work would be limited to the downstream face of Arrowrock Dam. During these construction seasons (September 15 to March 1), Arrowrock Reservoir would be held at an elevation no lower than 3110 feet and Lucky Peak Lake would be held at an elevation no higher than 3000 feet. These elevations provide a means of moving water downstream as needed to meet irrigation demand and to provide flood control.

In the third construction season, Arrowrock Reservoir would be drawn down to an elevation no higher than 3027 feet from September 15 to February 28. Lucky Peak Lake would be held at an elevation no higher than 3000 feet from September 15 to October 31 and 2962 feet from November 1 to March 1. These elevations would allow work to proceed on the upstream side of Arrowrock Dam in the dry with bulkheads in place and to pass flows downstream.

At least six of the conduits now controlled by Ensign valves would be operational at all times to pass Arrowrock Reservoir inflow. Because of potential storm events during the construction season, it is estimated that the sluice gates may need to be opened temporarily to pass flows.



RESERVOIR ELEVATIONS
ARROWROCK DAM CROSS SECTION

Figure S-1

Mitigation for Alternative A allow flooding of the work area for up to 5 cumulative days before the sluice gates would be operated. As a result, there is only 15 percent chance that the sluice gates would be opened during the third construction season.

After completion of construction, neither Arrowrock Reservoir nor Lucky Peak Lake would need to be drawn down for maintenance work associated with Arrowrock Dam outlets.

The capital cost of Alternative A is estimated at $15 million, and annual operation, maintenance, and replacement costs for a 50-year period are estimated at $564,000. The present worth value of the capital cost for comparison with the No Action Alternative is $12,900,000.

Alternative B – Replace Lower Row of Ensign Valves with Clamshell Gates, Reservoir Elevation 3007 feet in Construction Year 3.

Alternative B is identical to Alternative A in facilities and in construction through the second construction season. Drawdown of Arrowrock Reservoir for the third construction season would be earlier, to a lower level, and for a shorter period than Alternative A (see figure S-1).

In the third construction season, Arrowrock Reservoir would be drawn down to elevation 3007 feet from September 1 to November 7. During this period, Lucky Peak Lake would be held at an elevation no higher than 2962 feet. These elevations would allow work to proceed much more quickly on the upstream side of Arrowrock Dam as bulkheads would not be needed to work in the dry.

The Alternative B trade-off for being able to work more quickly is that Arrowrock Reservoir would have a pool of only 160 acre-feet and the sluice gates would be used continuously during the drawdown to pass inflow. Because of the relatively short and early construction season, it is unlikely that potential storm events would exceed the capacity of the sluice gates and flood the work area.

After completion of construction, neither Arrowrock Reservoir nor Lucky Peak Lake would need to be drawn down for work on the Arrowrock Dam outlets.

The capital cost of Alternative B is estimated at $14.6 million, and annual operation, maintenance and replacement costs for a 50-year period are estimated at $564,000. The capital cost of Alternative B may be somewhat less than Alternative A. The present worth value of the capital cost for comparison with the No Action Alternative is $12,500,000.

Alternatives Considered But Not Carried Forward

Reclamation began considering modification of Arrowrock Dam outlet works in 1982; some conceptual designs for replacement of some of the Ensign valves were developed in 1983. Increasing maintenance problems resulted in more intense efforts to identify and evaluate solutions to the maintenance problems associated with the now 85-year old Ensign valves. In the following years, various possible designs were identified and evaluated, and in 1987 a conceptual design suggested clamshell gates. Other potential elements, features, and construction methods,

were also identified and evaluated. In the 1990's the focus has been on limiting reservoir drawdown and potential impacts to water supply and natural resources.

Construction periods of 2 years and 4 years with various measures to maintain higher pool elevations were identified and analyzed. All 2-year construction alternatives were eventually eliminated as too short to feasibly complete construction. All 4-years construction periods using a cofferdam, a pressure vessel, and divers were rejected. A cofferdam is not considered practical due to concrete deterioration and associated potential for leakage and concerns for safety to workers. A pressure vessel was rejected on the basis of extraordinary costs. Use of divers was rejected on the basis of cost and inability to meaningfully improve Arrowrock Reservoir water level elevation during construction.

Affected Environment

Reservoir Operations

The three storage dams on the Boise River system are cooperatively operated for irrigation water supply and flood control. To the extent possible within those parameters, the storage reservoirs are also operated for fish and wildlife, recreation, and water quality enhancement. Approximately 40,000 acre-feet of water have been annually released from the Boise River in recent years for anadromous salmon flow augmentation in the lower Snake River. Power production at Anderson Ranch Powerplant and Lucky Peak Powerplant are incidental to other operations, i.e., water is neither retained nor released specifically for power generation.

Total active storage capacity of the system is 960,000 acre-feet. Flood control operations during the winter through June determine water content particularly in Arrowrock Reservoir and Lucky Peak Lake. At the same time, the reservoirs are filled within flood control parameters to meet irrigation water supply needs. During reservoir draft to supply irrigation demands, Anderson Ranch and Arrowrock Reservoirs are drawn down first. Lucky Peak Lake is maintained as high as possible through the recreation season, but is usually rapidly drawn down after Labor Day to meet irrigation needs downstream. From September to March, Arrowrock Reservoir elevation normally ranges from 3184 to 3078 feet and Lucky Peak Lake elevation normally ranges from 2972 to 2943 feet.

Water Quality

Water quality is normally good throughout the system downstream to the city of Boise. Water quality degrades further downstream due to storm runoff, treated effluent, municipal contributions, and irrigation return flows. Because of water quality concerns, total maximum daily loads have been defined for sediment and bacteria for the lower Boise River.

Threatened and Endangered Species

Four species listed as threatened or endangered under the Endangered Species Act may occur in the affected area. These are bull trout, bald eagle and Ute ladies' tresses which are listed as threatened and the gray wolf which is listed as endangered.

Bull trout are the primary concern and are found in Arrowrock Reservoir and upstream in the South Fork (including Anderson Ranch Reservoir), Middle Fork, and North Fork of the Boise River. Movements of bull trout, which are sometimes entrained through Arrowrock Dam into Lucky Peak Lake, have been and continue to be studied. Adfluvial forms mature over a period of years in a lake or reservoir, migrate upstream to spawn and return to reside in the lake or reservoir for about 6 months each year. These forms are found in Anderson Ranch and Arrowrock Reservoirs. Bull trout that are entrained into Lucky Peak Lake are lost to the reproducing population. Reclamation is required under a 1999 biological opinion of the U.S. Fish and Wildlife Service to eliminate or reduce bull trout entrainment and to develop a minimum conservation pool at Arrowrock Reservoir.

Five bald eagle nesting pairs are found in the area; three upstream of Anderson Ranch Dam and two at Arrowrock Reservoir. Wintering bald eagles are found throughout the system from Anderson Ranch Reservoir to the lower Boise River.

Gray wolves have been documented in the North and South Fork Boise River drainages and there are unconfirmed reports of wolves near Arrowrock Reservoir and Lucky Peak Lake.

Ute ladies' tresses, a perennial orchid that grows in wetland and riparian habitat, has been recorded in Idaho but only in the eastern part of the state.

Although not found in the Boise River, Snake River spring/summer chinook, fall chinook, and steelhead are also a consideration as water from the Boise River is used for salmon flow augmentation in the lower Snake River.

Fish

In addition to bull trout, numerous fish are found in the reservoirs and various reaches of the Boise River. These include cold water and warm water species such as rainbow trout, mountain whitefish, smallmouth bass, and yellow perch. The rainbow trout fishery is supported primarily by stocking, although some wild redband trout are present. Arrowrock Reservoir has in recent years been annually stocked with an average of 120,000 rainbow trout fingerlings, 15,000 Kamloops/steelhead hybrids, and 8,000 fall chinook salmon fingerlings. Nongame fish species found in the reservoir include largescale sucker, bridgelip sucker, northern pikeminnow, redside shiner, chiselmouth, sculpins, and dace.

Vegetation and Wildlife

The shoreline of the reservoirs is generally devoid of riparian vegetation due to fluctuations in reservoir elevations. The hills surrounding the reservoir are generally covered with a sagebrush steppe community, and river reaches tend to have a well developed riparian community that includes black cottonwood.

Wildlife, in addition to endangered and threatened species, include migratory herds of mule deer and elk, waterfowl, shorebirds, and upland birds. More than 150 species of birds, 37 species of mammals, and a variety of reptiles and amphibians are found along the rivers.

Recreation

All of the reservoirs provide flatwater boating, fishing, camping, and other recreation opportunities. As the water level of the reservoirs decline through the summer, recreation opportunities and quality of experience diminish. Lucky Peak Lake provides the greatest recreation opportunities and serves one of the largest populations centers in the State of Idaho. River reaches are also used extensively including the reach that runs through the city of Boise.

Economics

The population of the three-county area–Ada, Canyon, and Elmore–is about 426,000; total population of the State of Idaho is about 1.2 million. Services, retail trade, and manufacturing are the dominant employment sectors. Although farms and agricultural services account for only 4.1 percent of the employment, much of the land and 90 percent of the water of the Boise River storage system are used for irrigated agriculture.

There are two large hydroelectric powerplants in the areas. Anderson Ranch Powerplant is owned and operated by Reclamation, and Lucky Peak Powerplant is owned by several irrigation districts and operated by Seattle City Light, a department of the city of Seattle. Annual generation of the two larger powerplants, Anderson Ranch and Lucky Peak, have averaged 153,562 megawatt-hours and 350,000 megawatt-hours respectively in recent years.

Cultural Resources

Arrowrock Dam is listed in the National Register of Historic Places for its significance in engineering and regional agricultural growth.

There are some recorded prehistoric sites in the vicinity of Arrowrock Dam and Reservoir. Of particular note, is a temporary Indian encampment established in the 1860's near the mouth of the South Fork Boise River. It is suspected that the site may contain burials. The Shoshone-Paiute and Shoshone-Bannock Tribes regard that site and possibly other sites below the full pool elevation of Arrowrock Reservoir as having traditional cultural, religious, and historic values.

Reclamation commits to further consultation with the affected Tribes on a government-to-government basis to avoid, minimize, or mitigate effects in accordance with 36 CFR 800, Executive Order 13007, and Reclamation policy. Consultations will include traditional cultural properties and sacred sites.

Indian Trust Assets

The Shoshone-Bannock Tribes located at the Fort Hall Reservation may have trust assets of hunting and fishing rights in the area. The Shoshone-Paiute and Shoshone-Bannock Tribes have strong cultural and religious interest in the area of Arrowrock Dam.

Indian Sacred Sites

The area around what is now Arrowrock Reservoir, including lands below the full pool elevation is regarded by the Shoshone-Paiute and the Shoshone-Bannock Tribes as having sacred value, particularly the location of the 1860's encampment at the mouth of the South Fork Boise River. The site may contain burials.

Environmental Consequences

Facilities, costs, economic effects, and environmental effects are listed in the Table S-1.

- Areas, resources, and operations not impacted or not measurably impacted by any of the alternatives include:
  - Flood Control operations, salmon flow augmentation ,wetlands, air quality, noise, and social conditions
  - Anderson Ranch Reservoir and the South Fork Boise River from Anderson Ranch Reservoir to Arrowrock Reservoir and the resources within those areas.
  - Environmental Justice
  - Gray wolf and Ute ladies' tresses
  - Snake River spring/summer chinook, fall chinook, and steelhead
  - Vegetation
  - Irrigation water supply (except in a very dry period)
  - Indian Trust Assets

Impact highlights

- Arrowrock Reservoir
  - Alternative A and B would result in only 1 drawdown compared to No Action with 9 drawdowns in 50 years
  - Alternative B drawdown would be deeper but of shorter duration than Alternative A

- Lucky Peak Lake
  - Alternative A and B would result in only 3 drawdowns compared to No Action with 9 drawdowns in 50 years
  - Alternative B drawdown in the third year would be start sooner and be for a shorter period than Alternative A

- Water Quality
  - Water quality impacts of each alternative could affect Arrowrock Reservoir (increases in turbidity and total suspended solids), Lucky Peak Lake (increases in turbidity and total suspended solids), and the lower Boise River (Total Maximum Daily Loads would likely be exceeded)
  - Water quality impacts of Alternatives A and B would be less than No Action
  - Alternative A water quality impacts would be less than Alternative B (less than 15 percent change of operating the sluice gates) and likely to be somewhat less in Lucky Peak Lake and the lower Boise River (Total Maximum Daily Load may be exceeded)

- Threatened and Endangered Species
  - Bull Trout
    - All alternatives would risk loss of bull trout by stranding, mortality, and entrainment. Alternatives A and B would result in less risk of loss than No Action
    - Alternative A may result in less risk of loss than Alternative B
  - Bald Eagles
    - All alternatives would risk some loss of nesting productivity of bald eagle pairs at Arrowrock Reservoir
    - Alternatives A and B could result in short term loss of nesting productivity versus long term loss under No Action
    - All alternatives would reduce foraging opportunities for wintering bald eagles in some areas and enhance foraging opportunities in other areas. No Action would have the most adverse effect

- Arrowrock Reservoir Fishery
  - All alternatives would temporarily eliminate most of the Arrowrock fishery (entrained to Lucky Peak Lake and/or killed due to high levels of suspended sediment). Mitigation measures (for stocking rainbow trout) could result in recovery in 2-3 years; 1-4 years recovery for non-game fish
  - Alternatives A and B would be less adverse than No Action
  - Alternative A impacts would be less adverse than Alternative B (due to a shorter period of high levels of suspended solids and only a 15 percent probability of using the sluice gates)

- Lucky Peak Lake Fishery
  - Fish kills could be expected with No Action and Alternative B, but Alternative B impact would be less than No Action
  - Alternative A could temporarily enhance the fishery due to entrainment from Arrowrock Reservoir; fish kills due to suspended solids are not likely

- Wildlife
  - All alternatives would have minor impacts on wildlife, temporary loss of open water habitat for waterfowl, enhanced feeding opportunity for shore birds, and hampered foraging by fish eating species
  - Alternative A and B impacts, adverse and beneficial, would be less than No Action
  - Alternative A impacts on foraging of fish eating species would be less than Alternative B

- Recreation
  - All alternatives would have a minimal adverse effect on recreation at Arrowrock Reservoir.
  - Alternative A and No Action would have minimal adverse impacts at Lucky Peak Lake compared a significant adverse impact in 1 year for Alternative B.
  - No Action would have no impact on recreation in the lower Boise River compared to a significant 1-year adverse impact for Alternatives A and B. The adverse impacts of Alternative B would be about 4 fold of Alternative A

- Economic
  - Irrigation Economics
    - All alternatives would result in a minor (too small to calculate) adverse impact
    - Alternative A and B impacts would be less than No Action
  - Hydropower Economics
    - All alternatives would result in a minor loss of hydropower generation
    - Economic value lost compared to No Action would be $740,000-$1,285,000 for Alternative A and $1,115,000-$1,786,000 for Alternative B over a 4-year period
  - Recreation Economics
    - No Action would have a minimal impact on recreation.
    - Alternative B would result in an economic loss of about $5 million compared to $314,100 for Alternative A

- Financial Effects
  - Arrowrock Reservoir space holders would repay 46 percent of the costs, the remaining 54 percent of costs would be paid by the United States
  - Alternative A and B financial obligation of Arrowrock Reservoir spaceholders would be about $6.9 million and $6.7 million respectively compared to a $15.6 million obligation for No Action

- Cultural Resources
  - All alternatives would incrementally increase the potential adverse impacts to archeological and traditional cultural properties through exposure of usually inundated terraces to vandalism or looting, and perhaps also new or different erosional processes. Impacts would be mitigated for in all alternatives
  - Alternatives A and B would have less potential for adverse impact than No Action
  - Alternatives A and B would adversely impact the historic integrity of Arrowrock Dam, which is listed on the National Register of Historic Places. Impacts would be due to removal of original valves and associated equipment and placement of new features on the dam exterior. Impacts would be mitigated

- Indian Sacred Sites
  - All alternatives would incrementally increase the potential to impact Indian sacred sites through physical disturbance due to erosion, looting, and vandalism in the Arrowrock Reservoir pool. Impacts would be mitigated for all alternatives
  - Alternatives A and B would have less potential for adverse impacts than No Action

- Indian Trust Assets
  - May impact the populations of fish and other game to some extent. Access to hunting and fishing areas would not be affected. None of the alternatives would affect tribal hunting and/or fishing rights.

- Cumulative Effects
  - No significant cumulative effect to any resource category.

Summary Table

Table S-1. Summary of Alternatives			
	Alternative		
Item	No Action	A (Preferred)	B
Facilities			
Spillway	No change	No change	No change
Upper row of Ensign valves	Retained	Abandoned but left in place	Abandoned but left in place
Lower row of Ensign valves	Retained	Replaced with clamshell gates	Replaced with clamshell gates
Sluice gates	Retained	Abandoned but left in place	Abandoned but left in place
Construction or Major Maintenance			
50 year period	9 years (Years 1, 3, and every sixth year thereafter)	3 construction seasons (parts of 4 water years)	3 construction seasons (parts of 4 water years)
Scheduled Arrowrock Reservoir Elevations (Elevations reflect Water/Reservoir Operations Modeling)			
Total drawdowns (50-year period)	9	1	1
Year 1 (elevation)	3007 feet for 2 months	>3110 feet	>3110 feet
Year 2 (elevation)	Normal operation	>3110 feet	>3110 feet
Year 3 (elevation)	2975 feet for 5 months	3027 feet for 5½ months	3007 feet for 9 weeks
Year 9, 21, 33, 45 (elevation)	3007 feet for 5 months	Normal operation	Normal operation
Years 15, 27, 39 (elevation)	2975 feet for 5 months	Normal operation	Normal operation
Scheduled Lucky Peak Lake Elevations (Elevations reflect Water/Reservoir Operations Modeling)			
Total drawdowns (50-year period)	9	3	3
Year 1 (elevation)	2962 feet for 3 months (October 7-December 31)	3000 feet for 5½ months (September 15-March 1)	3000 feet for 5½ months (September 15-March 1)
Year 2 (elevation)	Normal operation	3000 feet for 5½ months (September 15-March 1)	3000 feet for 5½ months (September 15-March 1)
Year 3 (elevation)	2962 feet for 5 months (beginning October 1)	2962 feet for 5½ months (September 15-March 1)	2962 feet for 9 weeks (beginning September 1)
Year 9, 15, 21, 27, 33, 39, 45 (elevation)	2962 feet for 5 months (October -March 1)	Normal operation	Normal operation

Table S-1. Summary of Alternatives			
Item	Alternative		
	No Action	A (Preferred)	B
Cost			
Capital (present worth)	$11,000,000	$12,900,000	<$12,500,000
Capital (50-year life cycle)	$34,300,000	$15,000,000	< $14,600,000
Operation, maintenance, and replacement (50-year total)	$1,000,000	$564,000	$564,000
Water Quality			
Arrowrock Reservoir			
Years affected	9 of 50 years	1 year	1 year
Pool size	0 and 160 acre-feet in alternate drawdowns	1,500 acre-feet	160 acre-feet
Sediment outflow	<520 to 1,250 acre-feet (each drawdown)	0 to 10.5 acre-feet	Up to 1,250 acre-feet
Turbidity and total suspended solids	Temporary increases (each drawdown)	Temporary increases (less than No Action and B)	Temporary increases for shorter duration than No Action and A. (less than No Action)
Lucky Peak Lake			
Sediment inflow	<520 to 1,250 acre-feet in 9 of 50 years	0 to 10.5 acre-feet in 1 year	Up to 1,250 acre-feet in 1 year
Sediment accumulation	<345 to 830 acre-feet in 9 of 50 years	0 to 7.5 acre-feet in 1 year	Up to 830 acre-feet in 1 year
Turbidity and total suspended solids	Increases concentrations	Low levels unless sluice gates are operated	Increased concentrations
Total dissolved gases	Continued occasional elevated levels	Temporary increase in two construction seasons, long-term decrease	
Lower Boise River			
Main stem–Turbidity and total suspended sediment	Exceed turbidity standard and Total Maximum Daily Load targets in 9 of 50 years	Turbidity standard and Total Maximum Daily Load targets unlikely to be exceeded. May exceed 1 year if sluice gates required	Exceed turbidity standard and Total Maximum Daily Load targets in 1 year (shorter duration than No Action)
Lake Lowell–Turbidity and total suspended solids	Increased in 9 of 50 years	Probably no increase	Increase in 1 year
Anderson Ranch Reservoir, South Fork Boise River, and other Stream Reaches – No Impacts			

Table S-1. Summary of Alternatives			
	Alternative		
Item	No Action	A (Preferred)	B
Endangered and Threatened Species			
Bull Trout			
Mortality Risk			
Arrowrock Reservoir	High	Moderate	High
Lucky Peak Lake	Low[1]	Low[1]	Low[1]
Entrainment			
Arrowrock Reservoir	High	High (less than No Action)	High (less than No Action, greater than A)
Lucky Peak Lake	Low	Low	Low
Food Supply			
Arrowrock Reservoir	Total loss, 1-4 year recovery	Near total loss, 1-4 year recovery	Total loss, 1-4 year recovery
Lucky Peak Lake	Short term reduction	Minimal impact	Short term reduction
Bald Eagles			
Arrowrock Nesting Pair			
Food supply	Periodic short-term and long-term reduction	Short-term reduction	Short-term reduction
Productivity	Potential loss in 9 of 50 years	Potential loss (less than No Action and B)	Potential loss (less than No Action, greater than A)
Wintering Eagles			
Foraging opportunity	Degraded in some areas, enhanced in others (9 of 50 years)	Degraded in some areas, enhanced in others (less effect than No Action and B)	Degraded in some areas, enhanced in others (less effect than No Action, greater than A)
Gray wolf	No effect		
Ute ladies'-tresses	No effect		
Snake River salmon and steehead	No effect		

Table S-1. Summary of Alternatives			
Item	Alternative		
	No Action	A (Preferred)	B
Other Game Fish			
Arrowrock Reservoir (risk of loss)	Significant for 2-3 years of every 6 year period	Significant for 2-3 years	Significant for 2-3 years (greater than A)
Lucky Peak Lake	Significant impacts from turbidity, 1 year of every 6-year period	Likely no effect	Significant impacts from turbidity for 1 year
Vegetation and Wildlife			
Waterfowl (loss of open water habitat)	Fall and winter of 9 of 50 years	Fall and winter of 1 year	Fall of 1 year
Shorebirds (foraging opportunity)	Enhanced in fall of 9 of 50 years	Enhanced in fall of 1 year	Enhanced in fall of 1 year
Fish eating species (foraging opportunity)	Hampered due to turbidity increase in 9 of 50 years	Hampered in 1 year (less effect than No Action and B)	Hampered in 1 year (less effect than No Action)
Vegetation	Minor clearing of upland areas for construction staging		
Irrigation Water Supply Shortage[2]			
Number of times	9 in 50 years	1 year	1 year
4-year Cumulative Shortage – Total Shortages			
Wet period	65,200 acre-feet	None	None
Average period	121,600 acre-feet	55,000 acre-feet	None
Dry period	550,100 acre-feet	478,700 acre-feet	403,300 acre-feet
4-year Cumulative Shortage – Specifically Due to the Alternatives			
Wet period	Not applicable	0 acre-feet	0 acre-feet
Average period	Not applicable	55,000 acre-feet	0 acre-feet
Dry period	Not applicable	81,000 acre-feet	5,600 acre-feet
Recreation Effects			
Arrowrock Reservoir (recreation-days)	Minimal loss in 9 of 50 years	Slight increase in 2 years, slight loss in 1 year	Slight increase in 2 years, slight loss in 1 year
Lucky Peak Lake (recreation-days)	Minimal loss in 9 of 50 years	Slight loss in 3 years	Minor loss in 2 years -103,100 in 1 year
Lower Boise River (recreation-days)	None	Significant loss in 1 year -43,750 in an average to dry year -175,000 in a wet year	Significant loss in 1 year -175,000 in a wet, average, or dry year
Anderson Ranch	Slight increase in recreation use		
South Fork Boise River	No change in recreation use		

Table S-1. Summary of Alternatives			
	Alternative		
Item	No Action	A (Preferred)	B
Economic Effects			
Irrigation	Minor impacts in 9 of 50 years (not meaningful to calculate)	Minor impact in 1 year (less than No Action)	Very minor impact in 1 year (less than No Action and Alternative A)
Hydropower (4-year period) – Lucky Peak and Anderson Ranch Powerplants			
Generation	1,772,585 megawatt-hours	1,749,642 megawatt-hours	1,744,015 megawatt-hours
Economic value Low High	 $45.6 million $74.4 million	 $44.9 million $73.1 million	 $44.5 million $72.6 million
Incremental value (compared to No Action) High Low	 not applicable not applicable	 -$740,000 -$1,285,000	 -$1,115,000 -$1,786,000
Recreation			
Arrowrock Reservoir	Very minor negative impact in late season in 9 of 50 years	Slight positive impact in 2 years and slight negative impact in 1 year	Slight positive impact in 2 years and slight negative impact in 1 year
Lucky Peak Lake	Minimal negative impact in 9 of 50 years	Minimal negative impact	Significant benefit loss of $3,702,900 due to reduced access to facilities
Lower Boise River	No effect under average water conditions. Negative effect during a wet year	Benefit loss of $314,100 in an average or dry year Benefit loss of $1,256,500 in a wet year	Benefit loss of $1,256,500 in an average or wet year
Anderson Ranch Reservoir	Slight positive impact to late season recreation use compared to normal operations due to higher reservoir elevation		
South Fork Boise River	No effect to slight positive impact		
Total recreation monetary loss	None	-$314,100 in an average or dry year -$1,256,500 in a wet year	-$4,959,600
Financial Effects (Capital Costs)			
United States obligation (54 percent of costs)	$18. 4 million over 50-year life	$8.1 million	$7.9 million
Arrowrock Reservoir spaceholder obligation (46 percent of costs)	$15.6 million paid over 50-year project life	$6.9 million paid through construction period	$6.7 million paid through construction period

Table S-1. Summary of Alternatives			
Item	Alternative		
	No Action	A (Preferred)	B
Effects on Cultural Resources			
Archeological Sites/Traditional Cultural Properties			
Potential for physical disturbance due to erosion	Yes	Yes (less than for No Action and B)	Yes (less than for No Action)
Potential for looting or vandalism	Yes	Yes	Yes
Historic Dam	Minor, non-visible impact	Removal of original elements and alteration of appearance. Largely mitigated	
Effects on Indian Sacred Sites			
Potential for physical disturbance due to erosion	Yes	Yes (less than for No Action and B)	Yes (less than for No Action)
Potential for looting or vandalism	Yes	Yes	Yes
Effects on Indian Trust Assets			
Right to hunt and fish	No Effect		
Cumulative Effects			
Resources	No significant cumulative effect to any resource category		

[1]Higher risk for fish near Arrowrock Dam due to higher turbidity levels.
[2]Total annual diversion total by water condition are: wet period – 1,300,000 acre-feet; average period – 1,550,000 acre-feet; and dry period – 804,000 acre-feet.

1 PURPOSE AND NEED FOR ACTION

1 PURPOSE AND NEED FOR ACTION

This chapter states the proposed action, the purpose, and the need for that action. Background information is provided on the Boise Project and the problems experienced with the operation of the Arrowrock Dam **outlet works**.[1] In addition, scoping activities, other actions and activities related to the outlet work rehabilitation, legal authorities and constraints, and the organization of this Environmental Impact Statement (EIS) are summarized.

Proposed Action

The Bureau of Reclamation (Reclamation) proposes to rehabilitate the Arrowrock Dam outlet works by removing the 10 lower level **Ensign valves** and replacing those valves with 10 **clamshell gates**. The other outlets, 10 upper level **conduits** controlled by Ensign valves and the 5 **sluice** outlets controlled by **sluice gates** would be abandoned but left in place. During construction, the rehabilitation would require operational changes of the Boise River/reservoir system, including a prolonged **drawdown** of Arrowrock Reservoir.

The purpose of the proposed action is to enable Reclamation to continue to operate Arrowrock Dam and Reservoir to meet the project purposes of irrigation and flood control.

Need for Action

The current condition of the Arrowrock Dam outlet works presents an increasingly difficult maintenance problem. The Ensign valves, which control releases from the dam, have been in use since 1915 and have exceeded the design life (50 years) of such valves (see figure 1-1). Most of the valves have been damaged through prolonged use, and three valves in the lower row are currently out of service. The sluice gates on the sluice outlets, which are needed to empty the reservoir for inspection and maintenance of the lower level Ensign valves, are also damaged. Two of the five sluice gates are capable of only limited service due to a deteriorated condition. Based on the results of the last inspection (1987), major repairs and rehabilitation of the existing 20 valves and 5 sluice gates are needed to assure continued reliability over the long term.

The current condition of the valves also poses a problem related to potential failure. Failure of the valves in a closed position could result in not being able to maintain sufficient space for flood control and failure in the open position could result in loss of water for irrigation.

Maintenance procedures, which call for inspection and repair of the lower row of Ensign valves every 6 years, require that Arrowrock Reservoir be drawn down to a very low level. Drawdown to the required level for inspection and repair is a problem because the sluice gates, which must be operated to lower the reservoir level, also need repair. There are also environmental concerns associated with the drawdown of the reservoir and use of the sluice gates. Use of the sluice gates flushes **sediment** downstream. Extreme drawdowns and use of the sluice gates for inspection

[1] Bolding is used to highlight the first appearance of technical terms. These terms are explained in the Glossary.

and maintenance adversely affect bull trout, which are listed as threatened under the Endangered Species Act (ESA), and other fish and water quality. In anticipation of a long-term solution to the maintenance problem, Reclamation has deferred inspection and maintenance of the lower Ensign valves since 1988.

The condition of the lower Ensign valves inhibits Reclamation's ability to release sufficient flow to meet project purposes under some conditions. Due to susceptibility to damage, the lower bank of Ensign valves cannot be used under high pressure conditions, e.g., when the reservoir is nearly full. In years with high runoff, this operational constraint reduces the ability to release water for flood control operations.

Restricted flow capacity is also a problem in drought years. This occurs when there is a low head differential between Arrowrock and Lucky Peak. Under that condition it is not possible to pass adequate flows through Arrowrock Dam while maintaining the Lucky Peak Lake **elevation** for recreation. When Arrowrock Reservoir is at a target conservation pool elevation of 3078 and Lucky Peak is at a full pool of 3055, the seven operational valves can only pass 2,900 cfs. That contrasts with an irrigation demand of about 4,300 cfs. The proposed clamshell gates will allow a release of about 5,000 cfs in this scenario.

Because of the condition and age of the valves it is possible that some of the lower valves could malfunction and stick in either the open or closed position, requiring unplanned reservoir drawdown to repair the valves. Valves stuck in either position would reduce flood control flexibility and could result in some increased downstream flooding. Stuck valves during the irrigation season could also affect irrigation water deliveries.

Background

Location and Setting

The Boise River system in southwest Idaho consists of four major streams. Flowing generally southwest, the North Fork Boise River joins the Middle Fork Boise River about 18 **river miles** upstream and northwest of Arrowrock Dam. Flowing generally northwest, the South Fork Boise River joins the Middle Fork about 4 river miles upstream of Arrowrock Dam to form the main stem Boise River. The confluence now lies within the Arrowrock Reservoir pool. Mores Creek, flowing south, joins the main stem Boise River about 9 river miles downstream from Arrowrock Dam within the Lucky Peak Lake pool. The main stem flows generally westward past the cities of Boise and Caldwell to merge with the Snake River at the Idaho-Oregon border (see Location map).

The sparsely populated river basin upstream from the city of Boise is rugged, consisting mostly of narrow valleys and forested lands. Downstream of Lucky Peak Dam, the valley is wide and has been developed as one of the major agricultural areas in Idaho. This area, commonly called the Treasure Valley, is a major population center with about one-third of the total population of Idaho.

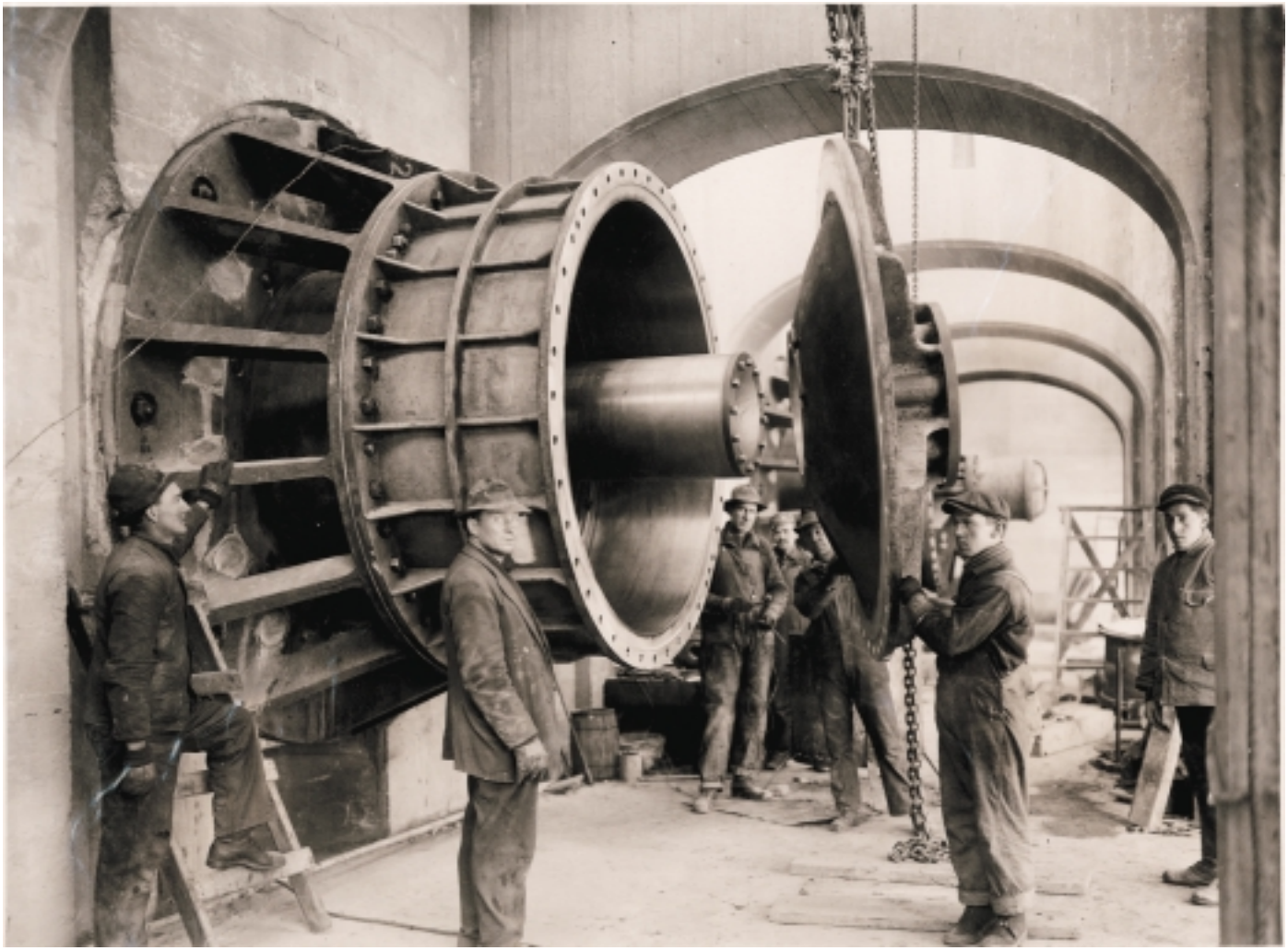


Figure 1-1. View inside the trashrack structure for the lower row of Ensign valves. The Ensign valve in the foreground has been installed on the upstream face of the dam and the valve cover is being moved into place for installation. (December 18, 1914)

Arrowrock Dam and the Boise River Storage System Operation

Arrowrock Dam, located on the main stem Boise River about 17 river miles upstream from the city of Boise, is operated as one of three storage facilities constructed on the Boise River. Anderson Ranch Dam and Reservoir, located on the South Fork Boise River and generally east of Arrowrock Dam, were completed by Reclamation in 1950 as part of the Boise Project. Lucky Peak Dam and Lake, located to the southwest and about 11 river miles downstream of Arrowrock Dam, were completed by the U.S. Army Corps of Engineers (Corps) in 1957.

Reclamation and the Corps operate the three storage dams in a coordinated method for irrigation water supply, flood control, recreation, and fish and wildlife. **Total storage capacity** of the system is about 1,058,300 **acre-feet**: Anderson Ranch Reservoir - 493,200 acre-feet, Arrowrock Reservoir - 272,000 acre-feet, and Lucky Peak Lake - 293,100 acre-feet. Of this total, about 70,000 acre-feet in Anderson Ranch Reservoir and Lucky Peak Lake are **inactive storage**; an additional 29,000 acre-feet in Anderson Ranch Reservoir is **dead storage**. All of the **active storage** space has been contracted to water users or assigned to specific purposes.

The three reservoirs are operated in accordance with the *Water Control Manual for Boise River Reservoirs* (Corps, 1985). This manual, developed jointly by Reclamation and the Corps under the authority of the 1944 Flood Control Act (58 Stat. 887), was adopted by Memorandum of Agreement dated September 25, 1985.

Specific operation of facilities and procedures to be followed at each of the three dams is included in the **Standing Operating Procedures** (SOP) for each facility. These instructions are highly detailed and include a wide variety of information among which are maximum reservoir content allowed, maximum release rates, maximum rate of change of releases, and maintenance and emergency procedures.

Operation of Arrowrock Dam outlet works is constrained by actual and potential **cavitation** damage to the lower Ensign valves and the sluice gates. Ensign valves in the lower row are not to be operated with a **hydraulic head** greater than 100 feet without special permission. The sluice gates may be operated only when the hydraulic head is 50 feet or less. In addition, three of the Ensign valves in the lower row and two of the sluice gates have been taken out of service and are considered inoperable or to be operated only in an emergency.

More detailed information on operations, including reservoir levels and seasonal changes, is discussed in Chapter 3.

Arrowrock Dam Facilities

Arrowrock Dam, located about 11 air miles east of the city of Boise (17 river miles upstream), was completed in 1915 as part of the Boise Project. The Boise Project is a Federal Reclamation project implemented to improve the irrigation water supply which had become over-appropriated. At the time of construction, Arrowrock Dam was the highest dam in the world. By the 1930's, the downstream face of the dam had so badly deteriorated that repairs were necessary. An

18-inch-thick layer of concrete was placed on the downstream face of the dam, the crest was raised 5 feet, and the **drum gates** on the **spillway** were raised 5 feet. This work was completed in 1937.

Figure 1-2 shows the existing Arrowrock Dam and Reservoir. In this photograph, water is being released through some of the upper Ensign valves and through the spillway on the right side of the dam.[1] Access to the Dam and Reservoir is by the Atlanta Road (Idaho Forest Highway 82), a gravel road that follows the right bank of the Boise River from State Highway 21 near the mouth of Mores Creek to the town of Atlanta. As shown in figure 1-2, access to the dam is across a bridge over the spillway to the road that crosses the crest of the dam.

Arrowrock Dam is a concrete, thick-arch structure, 350 feet high with a crest length of 1,150 feet. The crest width is 21.5 feet and the base width at the lowest point of excavation is 223 feet. The outlet works consists of 20 Ensign valves in two horizontal rows, 5 sluice gates, and a concrete spillway channel controlled by 6 drum gates. Figure 1-3 is a general cross section of Arrowrock Dam showing the elevation of the two rows of Ensign valves and the sluice gates. Figure 1-4, a photograph of the upstream side of Arrowrock Dam taken during construction, shows the upper row conduits, Ensign valves not installed, the two **trashrack** structures for the lower row of Ensign valves, and the trashrack structure for the sluice gates.

Throughout this document there are references to the Ensign valves by number. Ensign valves in the lower row are numbered from 1 to 10 starting on the left side of the dam and Ensign valves in the upper row are numbered 11-20 starting on the left side. All of the Ensign valves are 58 inches in diameter and installed on the upstream face of the dam. Seventeen of the conduits (4-20) are 52 inches in diameter and three conduits for valves (1-3) are 72 inches in diameter. The latter were designed for hydropower use that has never been developed.

Arrowrock Dam Maintenance

All of the Ensign valves, and the conduits downstream of those valves, have suffered some cavitation damage, but repairs have kept all the valves in the upper row and most valves in the lower row in service. One of the valves in the lower bank is considered inoperable, i.e., not to be operated under any condition, and two of the valves are to be operated only in an emergency. Through 1974, the sluice gates, which allow draining the reservoir, were operated in all drought years and when the reservoir level was drawn down to less than 50 feet above the sluice gates. Two of the five sluice gates are in need of repair and are to be operated only on a limited basis.

The SOP for Arrowrock Dam (Reclamation, 1999a) requires that the Ensign valves be inspected every 6 years and repaired as necessary. To accomplish the tasks of inspection and repair of the lower row, the reservoir was historically drawn down to elevation 3007 feet using the sluice gates. The last full inspection of the lower Ensign valves was in 1987; repairs were made in 1988. The sluice gates were last operated in 1988 to effect repair of the lower Ensign valves.

[1]Left and right, with reference to streams and hydraulic structures, are determined while facing downstream.

Figure 1-2. Arrowrock Dam and Reservoir. Aerial photograph looking upstream showing discharge from the spillway and some of the upper level outlets. Access to the dam is from the road on the left and across the spillway bridge. The road on the right provides access to the down stream side of the dam.
(July 12, 1980)

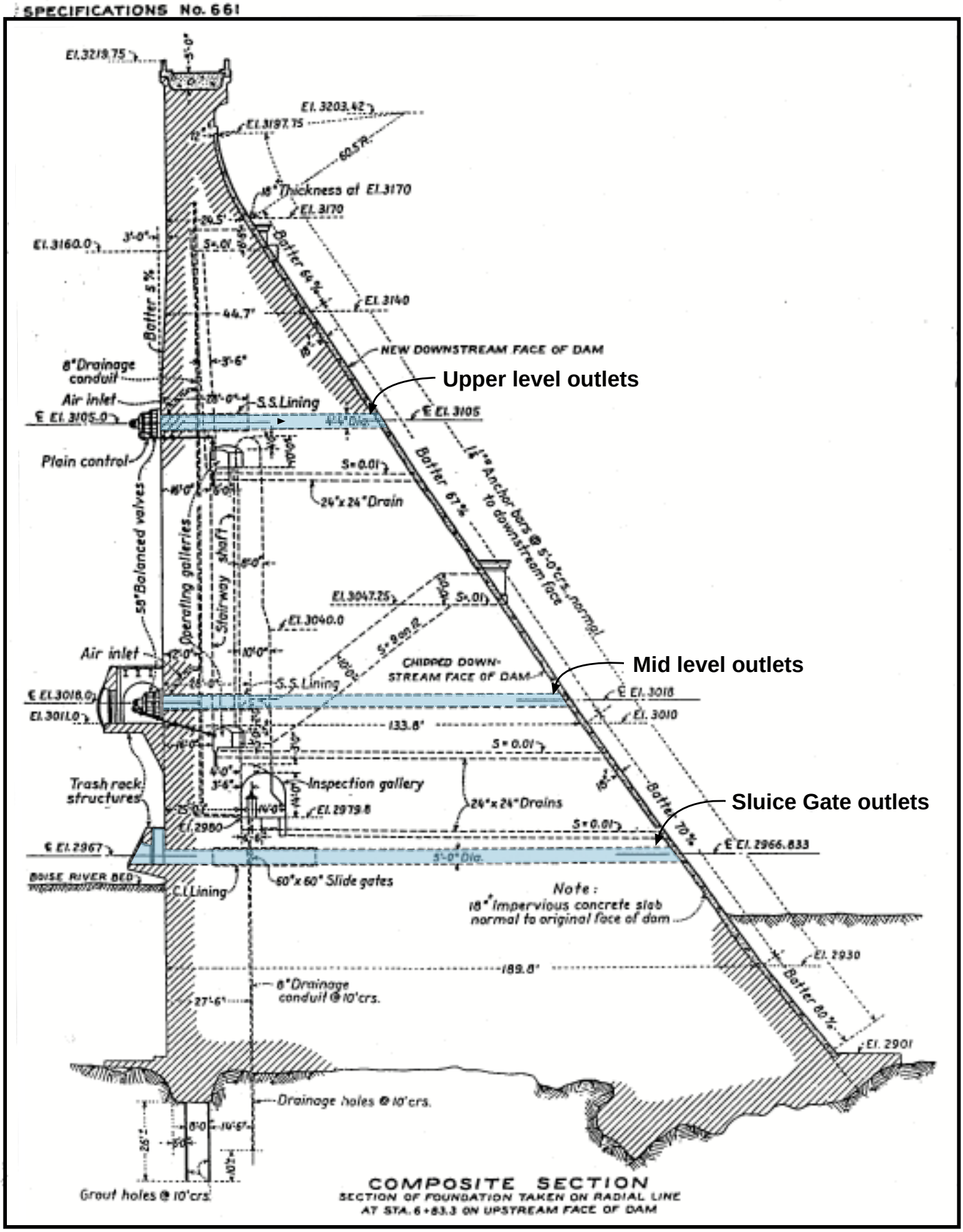


Figure 1-3. Cross-section of Arrowrock Dam from original design drawings.

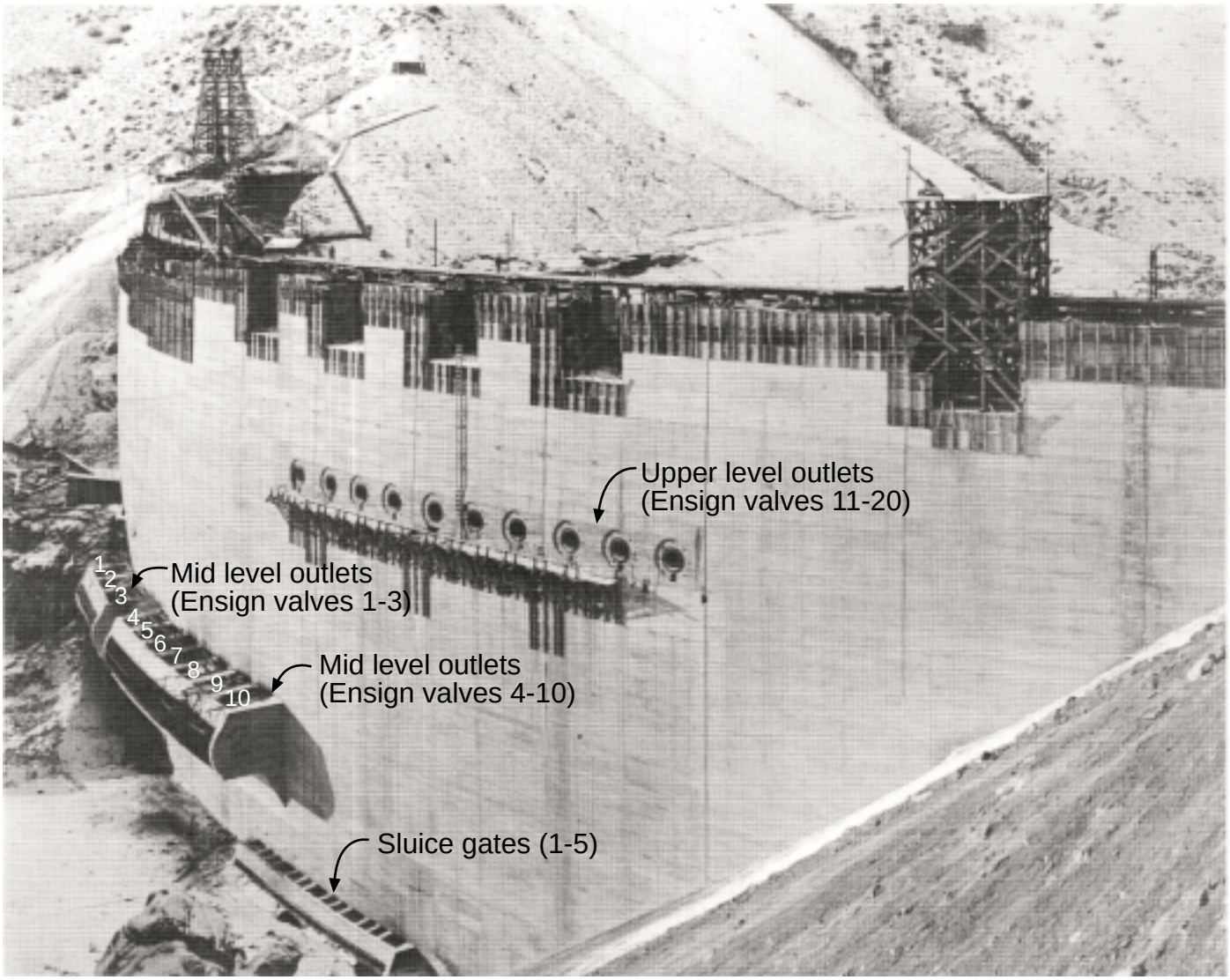


Figure 1-4. View of the upstream side of Arrowrock Dam during construction. The trashrack structure for the sluice gates is visible in the middle of photo above. To the left are the two trashrack structures for the lower row of Ensign valves. Ensign valves for the upper row of conduits have not been installed at this stage of construction. *(December 3, 1914)*

Inspection and repair of the lower Ensign valves and the sluice gates since 1988 have been deferred largely due to anticipation of developing a program to rehabilitate the outlet works.

The upper Ensign valves, which are normally exposed during part of the year, have been inspected and/or repaired every 1 or 2 years. Extensive cavitation repairs were made to the conduits down stream of the upper row of Ensign valves in 1995, minor repairs were made in 1996, and a complete inspection was made in 1997. Also in 1997, Ensign valve 14 was extensively overhauled due to complete malfunction of the valve. However, additional repairs that may be required were deferred pending a decision on a course of action for rehabilitating the outlet works.

Table 1-1 summarizes some major actions and the most recent maintenance history of the lower Ensign valves and the sluice gates.

Table 1-1. Historical and Recent Maintenance of Lower Ensign Valves and Sluice Gates

Year	Action	Finding or Result
1940	Inspected the lower Ensign valves	Removed valve #1 from service (inoperable)
1950	Overhauled the sluice gates	
1962	Inspected lower Ensign valves	Most were in good condition
1968	Inspected lower Ensign valves	Most in good condition, some epoxy repairs made
1973	Inspected lower Ensign valves	Most in good condition, some epoxy repairs made
1977	Inspected lower Ensign valves	Most in good condition, some repairs needed
1980	Inspected downstream of sluice gates	Recommended repair of sluice gate #5
1981	Inspected downstream of sluice gates and operated gates	
1987	Inspected sluice gates from downstream	Found some cavitation damage
1987	Inspected lower Ensign valves	Found extensive cavitation damage, removed valves #2 and #3 from service
1988	Lower Ensign valves	Repaired cavitation damage for valves #4-10
1988	Operated and inspected sluice gates	Found considerable erosion and downstream cavitation of gates #3 and #5, recommended that gates #3 and #5 be operated only for limited service

Scoping

The scoping process for this Draft Environmental Impact Statement (DEIS) provided an opportunity for the **public**, governmental agencies, and Tribes to identify their concerns and other issues and helped assure that a full range of potential solutions were identified. To accomplish this, Reclamation (1) published notices in the *Federal Register*, (2) provided information to the public through local media (3) met with potentially affected Indian Tribes,

(4) solicited oral and written comments from the general public and (5) held public meetings. A more detailed discussion of the scoping process is discussed in chapter 4.

Federal Register Notices

Reclamation published a "Notice of intent to prepare an environmental impact statement" in the *Federal Register* on October 20, 1998 (Vol. 63, No. 202, page 56047). The *Federal Register* is available at many libraries and via the Internet. A "Notice of public scoping meeting" was published in the *Federal Register* on November 13, 1998 (Vol. 63, No. 219, page 63493). Prior to issuing the Draft EIS, a "Notice of Availability and Public Hearing" was published in the *Federal Register* on October 26, 2000 (Vol. 65, No. 208, page 64234).

Scoping Document

On November 20, 1998, Reclamation mailed a scoping document to over 100 individuals, organizations, and agencies. The document discussed the deficiencies in the outlet works and a proposal to replace the lower ten Ensign valves with clamshell gates, requested comments, and included an addressed return mailer.

Scoping Meetings

Reclamation held two scoping meetings on December 14, 1998, one in the afternoon (1–3 p.m.) and one in the evening (7–9 p.m.) at the Federal Natural Resources Center building, 1387 S. Vinnell Way, in Boise, Idaho. The date and purpose of the meetings were (1) published in the local newspapers and other media and the *Federal Register*, (2) included in a separate news release, and (3) included in the scoping document identified above. The meetings were held in an informal setting which consisted of presentation of information, with natural resource specialists available to answer questions and take comments after the presentation.

In addition to the two scoping meetings, Reclamation has held other meetings with Federal and State agencies, reservoir spaceholders, and the Shoshone-Bannock, Shoshone-Paiute, and Nez Perce Tribes to discuss rehabilitation of the outlet works (see chapter 4 for additional details).

Results of Scoping

Response to scoping efforts was light; Reclamation received only five letters of comment. Expressed issues and concerns that are within the scope of this EIS are summarized by topic in table 1-2.

Reclamation summarized the comments and issues by topic in a letter mailed to those who commented and other interested individuals and agencies. The letter also identified comments on issues that were beyond the scope of this EIS and whether those issues would be addressed separately during the planning effort. A copy of the letter is included as appendix A.

Table 1-2. Identified Issues and Concerns	
Topic	**Issue or Concern**
Bull trout (listed under ESA as threatened)	Entrainment Stranding Water quality reduced Reservoir productivity decline Threat to ongoing Idaho State and Federal efforts to reestablish migratory bull trout
Bald Eagle (listed under ESA as threatened)	Loss of forage (fish)
Fish (all species)	Entrainment Stranding Displaced anglers Water quality impaired Reservoir productivity decline Flows in South Fork and lower Boise River adversely changed (lower or higher) Storage in Lucky Peak Lake for winter flows reduced
Wildlife	Wintering deer hazards (ice and mud) increased Waterfowl and shorebirds habitat/food supply reduced Osprey and furbearer habitat/food supply reduced
Hydrology/Water Supply	Operational scenarios fully considered for each alternative (e.g., dry, normal, and wet water years) Effects on Arrowrock storage contractors versus Lucky Peak storage contractors (potential inequity) Refill probability Winter flooding probability
Construction	Time frame for construction Alternatives fully considered
Economics	Discussion of cost allocation Cost comparison of all alternatives including the No Action Effects on irrigators (construction repayment and potential loss of storage) Impacts on recreational fishing
Water Quality	Sedimentation/turbidity increase (reservoirs and Boise River) Impairment of designated uses Effects on irrigators related to lower Boise River Total Maximum Daily Load (TMDL) Compliance with the Clean Water Act (CWA)
Recreation	Loss of fishing opportunities Angler displacement Boating and other water-based recreation opportunities reduced Hunting impacted
Cultural resources	Historic properties adversely affected Traditional cultural properties, sacred sites potentially exposed to damage
Transportation	Road improvements needed

Additional Public Involvement

A public review of the Draft EIS, issued on October 23, 2000, provided additional opportunities for public review and comment for a period of 60 days. Sixteen letters of comments were received. These letters and Reclamation's response can be found in Appendix K. Main areas of concern were economics, safety, dissemination of information/status updates, repayment, water quality, fish, and recreation impacts. Copies of this Final EIS are being sent to the addresses identified by an asterisk in the distribution list (Appendix H). In addition the Final EIS will be published on Reclamation's web page for approximately 1 month after the Record of Decision is published. As a result of the comments received, additional information was developed and analysis as appropriate were conducted for economics, water quality, fish and recreation.

A public informational open house to describe the problems and proposed action of rehabilitation of the outlet works was held on November 2, 2000. Approximately 63 individuals representing the general public, organizations, irrigation districts, Federal, State, and local agencies attended. Areas of main interest were fish and wildlife, economics, and recreation.

Two formal public hearings were conducted at the Idaho State Historical Museum on December 12, 2000. Seven individuals gave formal testimony at the first session, but no one wanted to give any testimony in the second session. Main areas of concern were economics, safety, dissemination of information/status updates, repayment, water quality, fish, and recreation impacts.

Related Actions and Activities

ESA Section 7 Consultation on Reclamation Operation and Maintenance Activities in the Snake River Basin Above Lower Granite Reservoir

In April 1998, Reclamation submitted a Biological Assessment (BA) of operations and maintenance of Reclamation projects in the Snake River Basin above Lower Granite Reservoir to the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). This document (Reclamation, 1998a) analyzed the effects of normal operation and maintenance activities for Reclamation projects in the Snake River basin, including the Boise River reservoirs, on species listed under the ESA.

In October 1999, the USFWS provided a Biological Opinion (BO) to Reclamation on this BA (USFWS, 1999). In the BO, the USFWS identified reasonable and prudent measures (RPM's) where Reclamation must comply with terms and conditions to be exempt from the prohibitions of Section 9 of the ESA. These terms and conditions are non-discretionary. The USFWS believes the following RPM's are necessary and appropriate to minimize the **take** of bull trout in the Boise River:

- Reduce the incidence of bull trout **entrainment** due to reservoir operations.

- Within existing authorities and voluntary partnership opportunities, work toward ensuring reservoir operations do not result in de-watering of Reclamation reservoirs to the extent that **adfluvial** bull trout resident there during part of their life history are not stressed or killed.

- Investigate methods to provide safe fish passage around Reclamation dams for bull trout, adults, and juveniles.

Beginning in April 1999, Reclamation initiated bi-monthly water quality sampling for a limnology study at Arrowrock Reservoir as part of investigation to potentially establish a conservation pool for Arrowrock Reservoir. Data collected over a 2-year period will be analyzed by a computer reservoir model to quantitatively define the effects of various pool elevations on dissolved oxygen depletion and water temperatures (key parameters relating to availability of salmonid **habitat** in reservoirs).

In the spring of 2000, Reclamation, under direction and guidance of Idaho Department of Fish and Game (IDFG) personnel, used gill nets and trap nets to capture bull trout in Lucky Peak Lake from April through June. Bull trout captured in Lucky Peak Lake were transported to Arrowrock Reservoir, and released. These trap and haul components are recommended by IDFG and USFWS to mitigate for bull trout entrainment through Arrowrock Dam and will be conducted in May of each year through the year 2003.

In an effort to reduce entrainment of bull trout, Reclamation has curtailed the use of the spillway drum gates at Arrowrock Dam. In the past, the drum gates were used to "top off" the reservoir since it is easier operationally to do so. Now, Reclamation is using the upper Ensign valves to adjust releases when filling the reservoir. Use of the spillway cannot be avoided completely as inflow may sometimes exceed the outflow capability of the outlets.

Bull Trout Research, North Fork of the Boise River

Reclamation and the United States Forest Service (USFS) are cooperating on a study of bull trout in the North Fork Boise River; the study began in 1999 and will continue until 2002. The objectives of this study are to: (1) examine the relationship of bull trout with habitat variation in rearing and spawning reaches; (2) quantify the North Fork migratory bull trout population, size, age, and growth structure; and (3) quantify migration patterns.

Arrowrock Dam Parapet Wall Replacement

During the winter of 1999-2000, Reclamation removed the upstream and downstream **parapet** walls which have decayed due to weathering. These walls atop Arrowrock Dam were replaced with reinforced concrete walls constructed to essentially duplicate the design and appearance of the original walls and changes were made to accommodate passage of larger vehicles. This replacement project, which has no effect on the operation of the dam or other possible construction activities, is covered by categorical exclusion checklist prepared by Reclamation.

Replacement of the parapet wall was determined to have an adverse effect upon the dam's historic integrity. **Mitigation** measures related to the historic integrity of the dam have been initiated. The new parapet wall was completed in the spring of 2000.

Arrowrock Bridge Replacement

The 1915 truss bridge spanning the spillway at Arrowrock Dam is scheduled to be replaced by a new bridge located upstream (east) of the existing bridge. The 1915 bridge is included in the National Register designation for the dam. Construction of a new bridge will have an adverse effect upon the dam's historic integrity. Mitigation measures will be to leave the 1915 bridge in place and complete Historic American Engineering Record (HAER) documentation of the dam and bridge. The proposed design of the new bridge is a concrete deck with metal railings oriented to eliminate the sharp turn which has generated problems in the maintenance and repair of facilities. In addition to the bridge, the access road leading from the left abutment to the left toe of the dam will be improved. To help preserve historic integrity, the 1915 bridge will not be removed.

Compliance with NEPA, the National Historic Preservation Act (NHPA), and pertinent other environmental laws will be completed prior to scheduled construction in March 2001; completion is scheduled for July 2001.

Arrowrock Dam Telephone Line Replacement

During the year 2001, Reclamation will replace approximately 6 miles of the existing antiquated telephone line located along the road between Spring Shores Marina and Arrowrock Dam. This replacement, designed to improve voice and data communication with Arrowrock Dam, will consist of replacing the overhead line with a new multi-circuit buried line. This project is scheduled to be completed in conjunction with the Federal Highway Administration project to pave this section of road.

Hydropower Development at Arrowrock Dam

The Federal Energy Regulatory Commission (FERC) licensed the Arrowrock Dam Project (Project No. 4656-013) on March 27, 1989 jointly to the Boise-Kuna, Nampa & Meridian, New York, Wilder, and Big Bend Irrigation Districts. After several unsuccessful attempts to find interested partners for the project, the licensees filed a request for a stay of the March 26, 1999 deadline. The licensees are currently seeking necessary legislation from Congress to formally extend the license. Draft legislation has been submitted and approval is anticipated.

In the spring of 2000, the licensees issued a public request for proposals for interested parties to submit plans for development of power at the site. As of February 1, 2001, a notice of application for amendment of the FERC license was submitted and comments on the proposed amendment were being evaluated. The amendment was an extension of the deadline for completion of construction to March 26, 2003 and that the deadline for completion of construction be extended to March 26, 2005.

Atlanta Road Improvement Project

The Federal Highway Administration, in cooperation with the USFS, Idaho Transportation Department, and the Atlanta Highway District, plans to improve 5.8 miles of the Atlanta Road (Idaho Forest Highway 82) from State Highway 21 to one-half mile west of Arrowrock Dam. The project includes paving the road to provide two lanes with shoulders, adding guardrails and signs, striping, and making minor drainage improvements. Construction is expected to begin in the spring of 2001 and be completed by July 2001.

Legal Authorities and Constraints

The Boise Project was authorized in March 1905 by the Secretary of the Interior under the authority of the Reclamation Act of 1902 (32 Stat. 388), and Arrowrock Dam was approved by the Secretary of the Interior on January 6, 1911. The original purpose of the project and Arrowrock Dam was irrigation and irrigation water supply. Anderson Ranch Dam, upstream of Arrowrock Dam, was authorized by the Secretary of the Interior under the authority of the Reclamation Project Act of 1939 for irrigation, flood control, power, and conservation of fish and recreation. Lucky Peak Dam, downstream from Arrowrock Dam, was constructed by the Corps for flood control and irrigation water supply under authority of the Act of July 24, 1946. The system of three dams is now operated in a coordinated manner to maximize (1) flood control in accordance with the *Water Control Manual for the Boise River Reservoirs* (Corps, 1985), (2) irrigation water supply, and (3) opportunities to enhance fish, wildlife, and recreation. The Water Control Manual identifies system operation for flood control, and the SOP for Arrowrock Dam (Reclamation, 1999a) identifies physical operating parameters and procedures to be followed.

Repayment contracts for Arrowrock and Anderson Ranch storage space and water service contracts for Lucky Peak storage have a major influence on the operation of the river/reservoir system. These contracts between Reclamation and irrigation districts and other spaceholders define annual payments and how the irrigation water supply is to be provided to the contracting entities.

Other laws that are relevant to the proposed action include:

- National Environmental Policy Act (NEPA) of 1969
- The Federal Clean Water Act (CWA), Section 205, 303, 305, 404
- Fish and Wildlife Coordination Act (FWCA) of 1958 (Public Law 85-624)
- Endangered Species Act of 1973 (Public Law 93-205)
- Idaho Stream Channel Protection Act, Title 42, Chapter 38, Idaho Code and Idaho Lake Protection Act, Section 53 et seq., Idaho Code
- U.S. Army Corps of Engineers permit for structures or work in navigable waters, Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403), etc.
- Idaho Water Quality Standards and Wastewater Treatment Requirements (IDAPA 58.01.02)

- The following Federal historical and cultural preservation acts:
  - National Historic Preservation Act (NHPA)of 1966 (Public Law 89-665) as amended (16 U.S.C. 470)
  - Archaeological Resources Protection Act of 1979 (16 U.S.C. 469-469c)
  - Native American Graves Protection and Repatriation Act (NAGPRA) (Public Law 101-601)

Document Organization

This EIS, with minor changes, closely follows the format recommended by the Council on Environmental Quality (CEQ).

Chapter 1 identifies the proposed action, the purpose, and the need for action; provides background information; and summarizes scoping activities and results, related actions and activities, and applicable laws and regulations.

Chapter 2 presents the alternatives and summarizes the process of formulating **action alternatives** and discusses the **No Action** and action alternatives. A comparison of the impacts of the alternatives is included in a matrix table.

Chapter 3 presents the affected environment and relevant resource components that make up the baseline environment and describes the environmental impacts of the alternatives considered in detail and identifies mitigation measures.

Chapter 4 summarizes consultation and coordination activities relevant to this EIS and includes a distribution list for this EIS.

In addition, the following have been included:

A List of Acronyms and Abbreviations (at the front of this EIS)
Bibliography–Chapter 5
List of individuals who helped prepare this EIS–Chapter 6
Glossary of technical terms–Chapter 7
Index–Chapter 8
Appendixes

2 ALTERNATIVES

2 ALTERNATIVES

This chapter summarizes the process of identifying feasible measures to restore the capability of Arrowrock Dam outlet works, identifies measures that were dropped from further consideration, and discusses the No Action and action alternatives.

The scoping process revealed that Federal and Idaho State agencies, private organizations, and interested individuals were primarily interested in the potential effects on natural resources and agriculture during the construction period and had little interest in the actual type or configuration of the valves. Tribal concerns include potential exposure of cultural resources during the anticipated drawdown(s) of Arrowrock Reservoir and potential impacts to bull trout. Irrigation districts were concerned about valve configuration to the extent that spaceholder costs would be affected. On this basis, the technical design selected for scoping was carried forward in each action alternative.

The focus of the description and evaluation of the effects of the alternatives in this document is the reservoir operations necessary for construction and future maintenance of the replacement outlet works at Arrowrock Dam and does not include optional type of valves or other outlet configurations. Short-term and long-term effects of the alternatives are discussed in chapter 3.

Formulation of Alternatives

Reclamation has evaluated several technical conceptual designs since 1980. Much of the early planning effort was devoted to identifying specific engineering elements and combinations that would meet operational requirements (see appendix B).

In 1997, a Reclamation value engineering (VE) group, armed with new information on clamshell gates met to evaluate several new outlet valve configurations and options. The VE team identified three options that would meet operational objectives and would permit abandonment, or partial abandonment, of the sluice gates and all of the remaining Ensign valves. Based on costs and operational capability, the preferred option selected in this evaluation is replacement of the lower row of Ensign valves with seven 48-inch diameter and three 66-inch diameter clam shell gates. This option was developed into a conceptual design in1997 and presented to the public in the scoping process. The conceptual design and the VE team findings are summarized in *Arrowrock Dam, Outlet Works Rehabilitation Conceptual Design* (Reclamation, 1998b).

After extensive investigation, two alternatives appear viable for removing the lower row of Ensign valves. One alternative is to install **stoplogs** in the trashrack structures and draw Arrowrock Reservoir down to slightly below the top of the trashrack structures, effectively maintaining the water level above elevation 3027 feet (about 20 feet above the level of the other option) but limiting access to the valves and lengthening the construction period. The other alternative is to draw Arrowrock Reservoir down to elevation 3007 feet (about 4 feet below the floor of the trashracks) to allow access to all the valves simultaneously, reducing the period of construction and the period of extreme drawdown of Arrowrock Reservoir. These alternatives differ primarily in the length of the construction period and the reservoir level during the third

year of construction. The first alternative would provide a somewhat larger pool of water in Arrowrock Reservoir for environmental considerations while the second alternative is simpler from a construction viewpoint. Also, with the first alternatives there would be only a 15 percent probability of sluice gate operation as compared to a 100 percent probability with the other alternative. These action alternatives as well as the No Action Alternative are described in detail below.

No Action Alternative

The No Action Alternative is defined as "the most likely future without the proposed action" and is the baseline for evaluating the effects of the action alternatives. In this case, the No Action Alternative is not the status quo operation scenario of the past 10 years.

Arrowrock Dam SOP states that the Ensign valves are to be inspected every 6 years and repaired as necessary. Although the valves in the upper row have received regular maintenance, maintenance work on the valves in the lower row has been deferred since 1988 due to high reservoir elevations and pending resolution of maintenance and valve replacement options. Currently, three of the lower valves are essentially inoperable, and the other seven valves and conduits continue to degrade. It is increasingly critical to repair the inoperable valves and to do maintenance work on the other seven valves to prevent possible valve failure. Two of the sluice gates are capable of only limited service due to a deteriorated condition and the other gates are in need of repair. Although the sluice gates are needed for certain operations, the Arrowrock Dam SOP provides no guidelines on periodic inspection of the sluice gates, and the last overhaul was in 1950.

As a result, the No Action Alternative would consist of an intensive repair and rehabilitation program for the lower row of Ensign valves and the sluice gates. Periodic reservoir drawdowns, a drawdown every 6 years, would be necessary for working in the dry. Those drawdowns would be for longer durations than in the past because of the need for major overhaul of the lower Ensign valves and sluice gates and a more aggressive maintenance program. Stoplogs would need to be installed in the trashrack structure of the sluice gates when work is performed on the sluice gates; reservoir inflow would be passed through other sluice gates. Maintenance of the lower valves and sluice gates would be in accordance with the SOP. Historically, Arrowrock Reservoir was drawn down to elevation 3007 to accomplish inspection and repair of these valves. Specific information on how this would be accomplished can be found in appendix B (see pages B7-B8).

Facilities

Valve components would be removed, repaired or remanufactured, and replaced for all valves. Intake ring damage would be repaired by welding, and steel liners which have suffered continued cavitation damage would be replaced. Major cavitation damage to concrete liners would be repaired as needed.

During the intensive repair and replacement program each sluice gate would be disassembled and overhauled.

Upper Ensign valves would continue to be inspected annually and repaired as needed. These valves would undergo a complete overhaul procedure as described for the lower Ensign valves. Maintenance of these valves does not require reservoir drawdown beyond normal operating elevations during the fall maintenance period.

Maintenance and Replacement Schedule and Reservoir Drawdown

The maintenance schedule shown in this section is based on known conditions of the facilities and professional judgement of what would most likely be needed to maintain those facilities in good operating condition for the long term after they have been completely overhauled.

The schedule for major overhaul and repair of the lower Ensign valves and the sluice gates to bring outlet facilities to full operational capability would require drawdowns in years 1, 3, and every sixth year thereafter is illustrated in figures 2-1 and 2-2. Drawdowns for inspection and repair would continue to be made at 6-year intervals for the life of the project. During drawdown of Arrowrock Reservoir for valve and gate maintenance, Lucky Peak Lake would not be allowed to rise above certain elevations, but these elevations would be within the range of normal fall and winter operation.

Table 2-2 summarizes required reservoir elevations for the overhaul and maintenance of the sluice gates and Ensign valves under the No Action Alternative.

Table 2-2. No Action Reservoir Operation During Maintenance Years

Item Overhauled[1]	Required Reservoir Elevations	
	Arrowrock Reservoir	Lucky Peak Lake
Sluice gates (with stoplogs)	≤2975 feet	≤2962 feet
Lower Ensign valves (without stoplogs)	≤3007 feet	≤2962 feet
Upper Ensign valves	≤3101 feet	≤3055 feet

[1] Trashrack structures for the sluice gates and the lower Ensign valves allow the placement of stoplogs to exclude water up to the top of the trashrack structure.

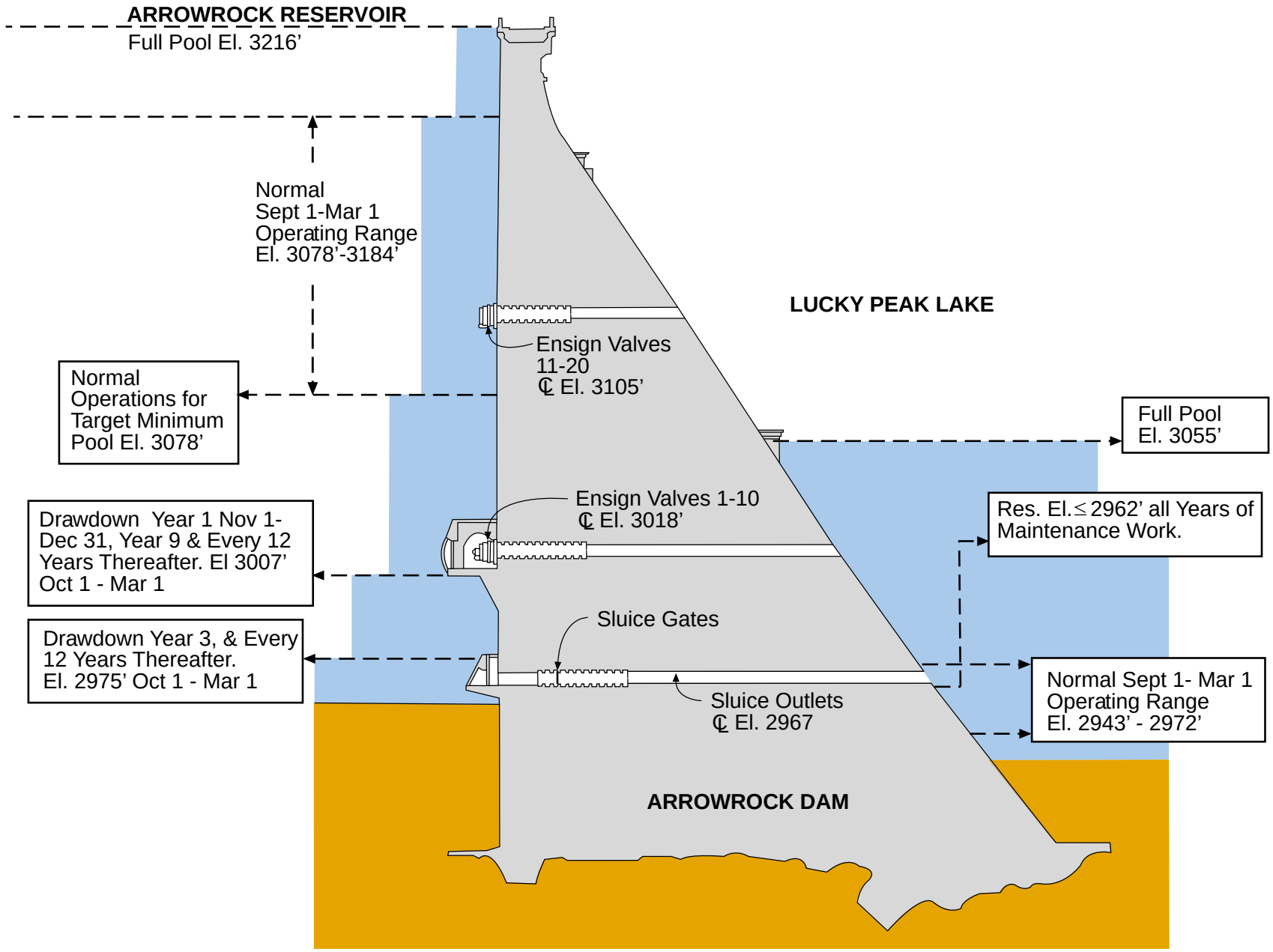
The drawdowns and the activities required for maintenance of the sluice gates and the lower row of Ensign valves are summarized in table 2-3. Maintenance activities related to the upper Ensign valves are not included as no special drawdowns are needed.

Figures 2-3, 2-4, and 2-5 are upstream and downstream view of Arrowrock Dam that provide a visual reference of a deep drawdown of Arrowrock Reservoir.

Table 2-3. No Action Maintenance Schedule (Shaded Area Indicates Reservoir Drawdown for Maintenance)[1]						
	Month					
Year	October	November	December	January	February	March - September
1		Inspect downstream side of sluice gates Inspect Ensign valves 2-10 and make minor cavitation repairs Reservoir elevations November 1 - January 1: Arrowrock – 3007 feet Lucky Peak – 2962 feet		Evaluate findings , prioritize activities, and draw up detailed plans		
3	Overhaul sluice gates 3 and 5 Overhaul Ensign valves 2, 3, and 4 Inspect and make minor repairs to Ensign valves 5-10 Reservoir elevations October 1 - March 1: Arrowrock – 2975 feet, Lucky Peak – 2962 feet					
9	Overhaul Ensign valves 5, 6, 7, and 8 Inspect and make minor repairs to Ensign valves 2, 3, 4, 9, and 10 Reservoir elevations October 1 - March 1: Arrowrock – 3007 feet, Lucky Peak – 2962 feet					
15	Overhaul sluice gates 1, 2, and 4 Overhaul Ensign valves 1, 9, and 10 Inspect and make minor repairs to Ensign valves 2-8 Reservoir elevations October 1 - March 1: Arrowrock – 2975 feet, Lucky Peak – 2962 feet					
21	Continue maintenance schedule Inspect Ensign valves 1-10 and make minor cavitation repairs and prioritize maintenance work Prioritize work and disassemble, inspect, clean, and repair 3 or 4 Ensign valves Assure that every Ensign valve is overhauled once each 18 years and sluice gates are inspected and repaired as necessary once every 12 years Reservoir elevations October 1- March 1: Arrowrock – 3007 feet, Lucky Peak – 2962 feet for inspection and repairs of the lower Ensign valves. Arrowrock – 2975 feet, Lucky Peak – 2962 feet for inspection and repairs of the sluice gates.					
[1]Lucky Peak elevations do not represent a drawdown but only a maximum elevation within normal operating parameters						

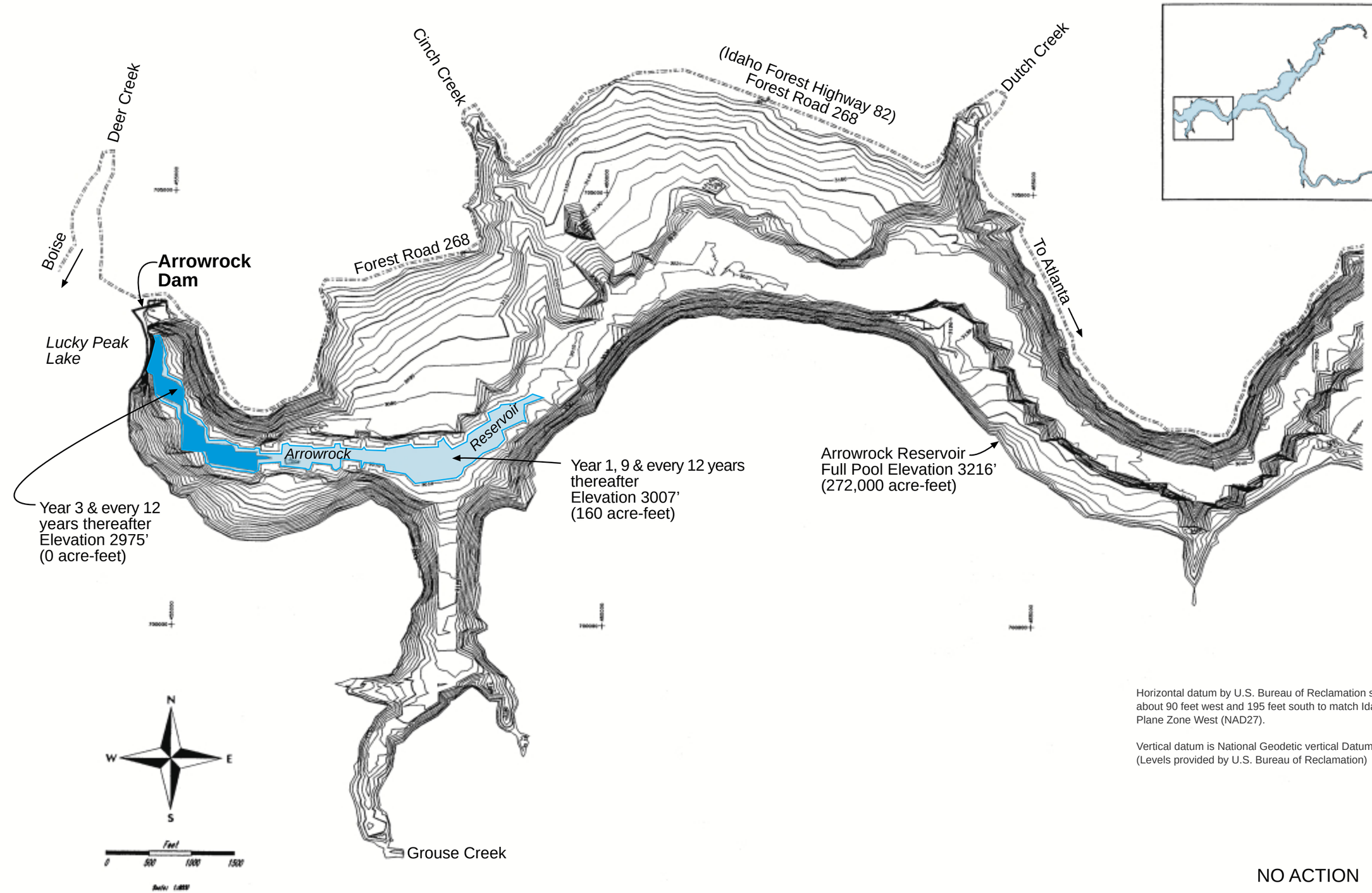
Staging, Materials, and Waste Materials

The primary staging area for maintenance of the lower Ensign valves will be the top of Arrowrock Dam. It is anticipated that the No Action Alternative will not involve any hazardous or other waste materials. But if any are involved, they would be handled in accordance with current laws, regulations, and standard procedures.



NO ACTION ALTERNATIVE
ARROWROCK DAM CROSS SECTION

Figure 2-1



Horizontal datum by U.S. Bureau of Reclamation survey. Must be shifted about 90 feet west and 195 feet south to match Idaho's state Plane Zone West (NAD27).

Vertical datum is National Geodetic vertical Datum of 1929 (Levels provided by U.S. Bureau of Reclamation)

NO ACTION

ARROWROCK RESERVOIR ELEVATIONS

Figure 2-2

Figure 2-3. View of Arrowrock Dam looking upstream. The outlets of upper and lower rows of conduits controlled by Ensign valves are visible on the left and center; sluice outlets are submerged and not visible. Staging for construction would be on the level area to the right. Lucky Peak el. 2970 *(Oct 1987)*.

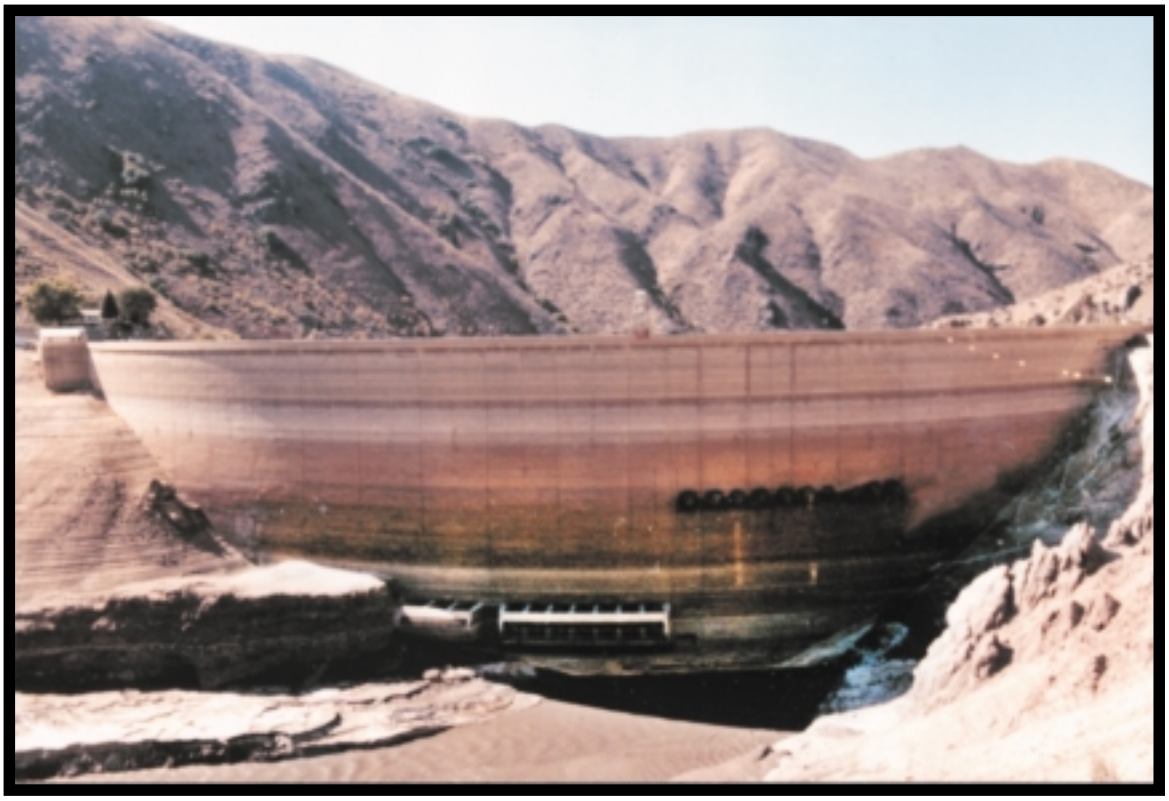


Figure 2-4. Looking downstream (west) at Arrowrock Dam from the north bank of the main stem Boise River. The estimated elevation of Arrowrock Reservoir is about 2985 feet (*Oct. 1987*)

Figure 2-5. Looking upstream (east) along the Boise River from the face of Arrowrock Dam. The high but unmeasured sediment load of the water is indicated by its chocolate coloring. The estimated elevation of Arrowrock is about 2985 feet. (*Oct. 1987*)

Reservoir Operation in Years Between Scheduled Maintenance

In years other than those scheduled for reservoir drawdown to effect maintenance of the lower Ensign valves and the sluice gates, the operation of Arrowrock Dam and Reservoir would be based on water supply and irrigation demands. That is, during these years there would be no change from normal operating parameters.

Costs

A 50-year life cycle cost analysis was made for the No Action Alternative. Capital costs are estimated at $34,300,000 and annual operation, maintenance, and replacement (OM&R) costs over a 50-year period are estimated to total $1,000,000. The capital cost estimate reflects periodic inspection and repair of the outlet facilities until all are fully operational. After that period continued inspection and repair as necessary are included in the OM&R estimate. The present worth value of the capital cost, assuming a 6.625 percent discount rate, is $11,000,000.

Alternative A (Preferred Alternative) – Replace Lower Row of Ensign Valves with Clamshell Gates, Arrowrock Reservoir Elevation 3027 Feet in Construction Year 3

Reclamation has identified Alternative A as the as the Preferred and Environmentally Preferred Alternative. Alternative A consists of replacing the 10 lower Ensign valves located on the upstream side of the dam with clamshell gates (seven 48-inch and three 66-inch) to be located on the downstream side of the dam. Associated structures and features include a control house and new gallery entrance for access to the clamshell gates, steel conduit liners, modified trashracks to accept a **bulkhead gate** for maintenance of the outlets, and a **bubbler** system to maintain an ice-free area of water for the guides for the bulkhead gate. The top row of Ensign valves and the sluice gates would be abandoned. It is anticipated that one or two of the Ensign valves removed would be retained for subsequent use as an interpretive exhibit at a Reclamation facility. Construction would require 3 years with a drawdown of Arrowrock Reservoir below normal operating levels in year three for construction on the upstream face of the dam.

Alternative A provides the largest possible pool for Arrowrock Reservoir while still allowing construction in a dry condition. Six or seven valves would be operational at all times to pass flows. This would help reduce the need to use the sluice gates to pass reservoir inflow. As an additional measure to reduce the likelihood of needing the sluice gates, the work area on the upstream side of the dam would be allowed to flood during storm events for up to 5 cumulative days before sluice gates are opened. Additional details on facilities and construction schedule are in appendix B (see page B-8).

Construction

Alternative A assumes a construction period of 3 years. Construction would require dry-site conditions which would be achieved through the use of stoplogs in combination with adjusting the levels of Arrowrock Reservoir and Lucky Peak Lake. To meet operational requirements and

complete construction in a 3-year construction period, construction would begin on September 15 and extend to March 1 in each year.

During the first 2 years, construction would be on the downstream face of Arrowrock Dam, and Lucky Peak Lake would be maintained at an elevation no higher than 3000 feet from September 15 to March 1. The elevation of Lucky Peak Lake must be held below this elevation during the first two construction seasons so that the contractor can access the lower levels Ensign valves on the downstream face of Arrowrock Dam and have access to a staging area just downstream (see figure 2-3). This elevation is lower than the normal elevation of Lucky Peak Lake during September but similar to winter month elevations.

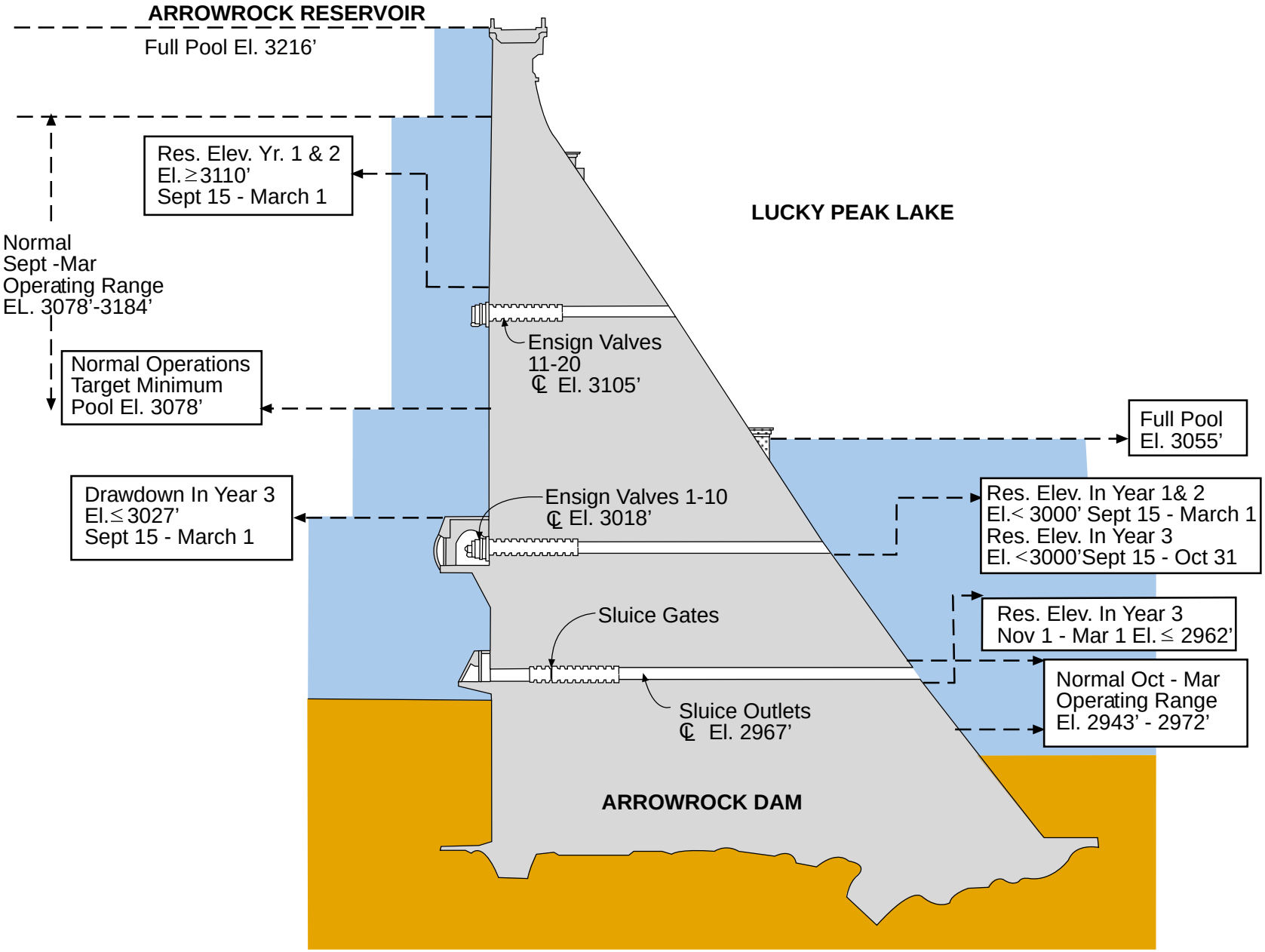
Arrowrock Reservoir, during the first 2 construction seasons, would be maintained at an elevation above 3110 feet from September 15 to March 1. This higher than normal fall elevation would be needed so that the upper row of Ensign valves will be below the surface of Arrowrock Reservoir, allowing these valves to be used to help pass upstream releases to meet downstream irrigation needs. Arrowrock Reservoir pool is normally drafted below the upper Ensign valves in the fall and refilled above the upper Ensign valves in the winter to avoid ice damage to the valves.

Access to the construction area would be across the new spillway bridge and the top of the dam to the road on the left abutment of the dam.

In the third construction season, activities would switch primarily to the upstream side of Arrowrock Dam. Arrowrock Reservoir would be drawn down and maintained at an elevation no higher than 3027 feet from September 15 to March 1. Lucky Peak Lake would be maintained at an elevation less than 3000 feet from September 15 to November 1 and would be maintained at an elevation of 2962 feet or less for the remainder of the construction season in case of a winter flood event. These Lucky Peak Lake elevations are somewhat below September levels but within normal winter operations. Figures 2-6 and 2-7 illustrate reservoir elevation and pool area during construction.

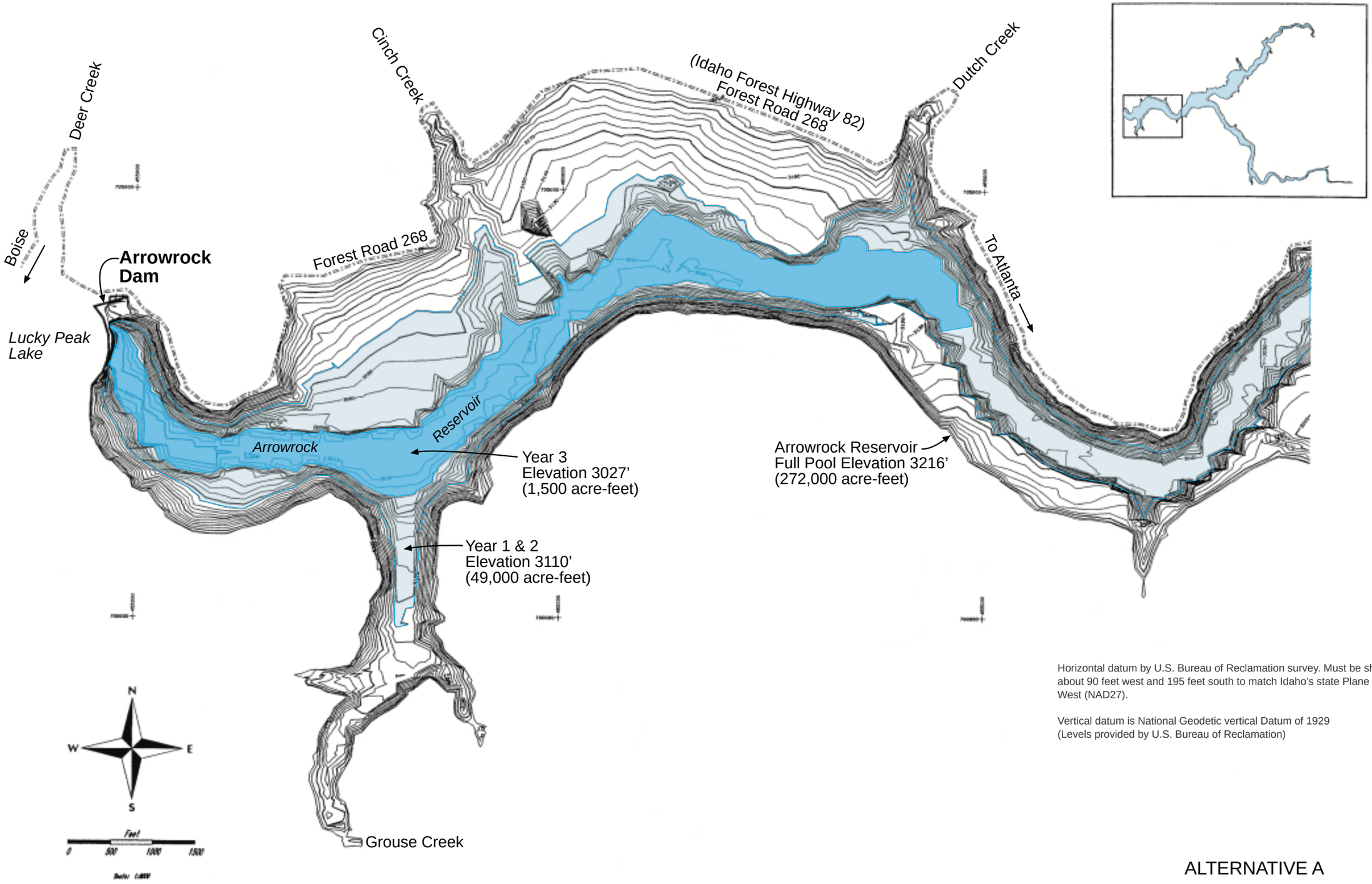
Inflow to Arrowrock Reservoir would be passed through the lower Ensign valves not being worked on and the completed conduits. It is anticipated that most winter storm events can be passed through these valves with the reservoir surface held at elevation 3027 feet. Use of the sluice gates would be avoided to the extent possible. However, sluice gates may be used if the construction work site is flooded more than 5 days cumulatively during the third construction. year. The probability of using the sluice gates is 15 percent.

The construction schedule and required reservoir elevations are summarized in table 2-4.



ALTERNATIVE A
ARROWROCK DAM CROSS SECTION

Figure 2-6



Horizontal datum by U.S. Bureau of Reclamation survey. Must be shifted about 90 feet west and 195 feet south to match Idaho's state Plane Zone West (NAD27).

Vertical datum is National Geodetic vertical Datum of 1929 (Levels provided by U.S. Bureau of Reclamation)

ALTERNATIVE A

ARROWROCK RESERVOIR ELEVATIONS

Figure 2-7

Table 2-4. Construction Schedule for Alternative A (Preferred Alternative) (Shading Indicates Construction and Reservoir Drawdown)[1]							
Year	Month						
	September	October	November	December	January	February	March - August
1		Mobilize for construction, excavate concrete for valves 1-3 and associated liners, place concrete for all gate structures and floor, and construct control house on downstream side of dam					
		Arrowrock ≥ 3110 feet, Lucky Peak ≤ 3000 feet					
2		Install steel liners and clam shell gates, place additional concrete for gate structures and roof, construct access tower, and install mechanical, electrical, and hydraulic controls					
		Arrowrock ≥ 3110 feet, Lucky Peak ≤ 3000 feet					
3		Install stoplogs, remove Ensign valves, install bell mouth liners and bulk head guides, and complete the installation of controls					
		Arrowrock ≤3027 feet Lucky Peak≤3000 feet	Arrowrock ≤3027 feet Lucky Peak ≤ 2962 feet				
[1]Lucky Peak elevations do not represent a drawdown but only a maximum elevation within normal operating parameters							

Staging, Materials, and Waste Materials

Construction staging areas will be developed on the downstream side of Arrowrock Dam and on the top of the dam. Disturbances of vegetation and land form will be minimized to the extent possible; vegetation would be replaced and the land reformed in accordance with current regulations and standards. Figure 2-8 identifies potential staging areas.

All materials, hazardous and other waste, will be handled in accordance with current laws, regulations, and standard procedures. That includes containing runoff from concrete cutting and other construction activities. Concrete waste will be disposed by burying it on site above the highwater line (see figure 2-8).

Sand, gravel, rock, and other raw materials for construction are readily available from commercial sources in the area.

Future Operation, Maintenance, and Replacement

Future operation of the river/reservoir system after completion of construction would continue to be based on flood control, irrigation water supply, and other project operation requirements. Maintenance of the outlet conduits and clamshell gates would be achieved between irrigation seasons by lowering the bulkhead gate to the selected outlet to provide dry conditions for inspection and repair. It is anticipated that normal end of season elevations of Lucky Peak Lake would be suitable for maintenance activities; below the elevation of the clamshell gates. The

upper Ensign valves and the sluice gates would remain in place for historical reasons but would not be operated, and no future maintenance or repairs would be required.

Costs

The estimated capital cost of Alternative A is $15 million. The present worth value of capital costs is $12,900,000. Total annual OM&R costs are estimated at $564,000 over a 50-year period.

Alternative B – Replace Lower Row of Ensign Valves with Clamshell Gates, Reservoir Elevation 3007 Feet in Construction Year 3

Outlet works facilities to be replaced under Alternative B are identical to Alternative A (see also appendix B). The difference between Alternative A and Alternative B is the period of drawdown and elevation of Arrowrock Reservoir in third construction season. Alternative B assumes a drawdown of Arrowrock Reservoir to elevation 3007 feet for a 9-week period, September 1 through November 7, during the third construction season. An elevation of 3007 feet is below the level of the lower Ensign valves and would allow worker access to all of the lower row of Ensign valves simultaneously. This would effectively reduce the time needed for construction and the complexity of the construction effort. Since the construction period would be limited to a normally low precipitation period, there would be little potential of a large storm event inundating the work area during construction. The sluice gates would be used to pass all incoming flows.

Construction

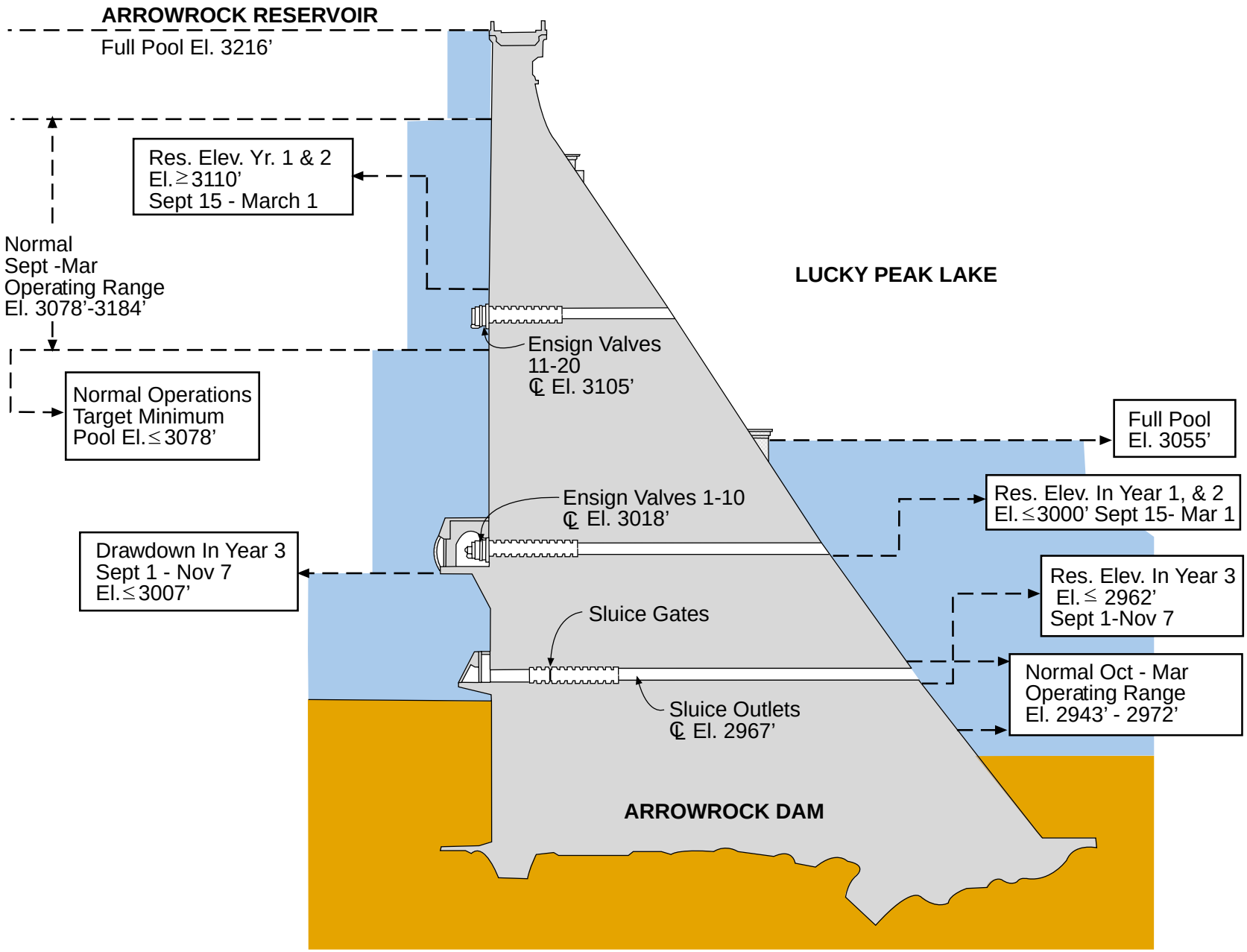
Alternative B assumes a construction period of 3 years and is identical to Alternative A except for the third year. In the third construction season, Arrowrock Reservoir would be maintained at elevation 3007 feet which is below the level of the Ensign valves and leaves only the sluice gates operational to pass flows. Lucky Peak Lake would be maintained at elevation no higher than 2962 feet which is below the elevation of the sluice gates. This elevation of Lucky Peak Lake would maximize the capacity of the Arrowrock sluice gates to pass flows. See figure 2-9 and figure 2-10 for illustrations of reservoir elevation and area during construction.

Completing construction in the 9-week period is critical as the likelihood of winter flood events that could not be handled by the sluice gates increases after this period. It is anticipated that prior to November 7 all inflow to Arrowrock Reservoir could be passed by the sluice gates. In the unlikely event that the work cannot be completed by November 7, stoplogs would be installed to isolate the uncompleted conduits to protect work areas from flooding. The completed conduits could be used to pass high inflows that surpass the capacity of the sluice gates.

The construction schedule and required drawdowns are summarized in table 2-5.

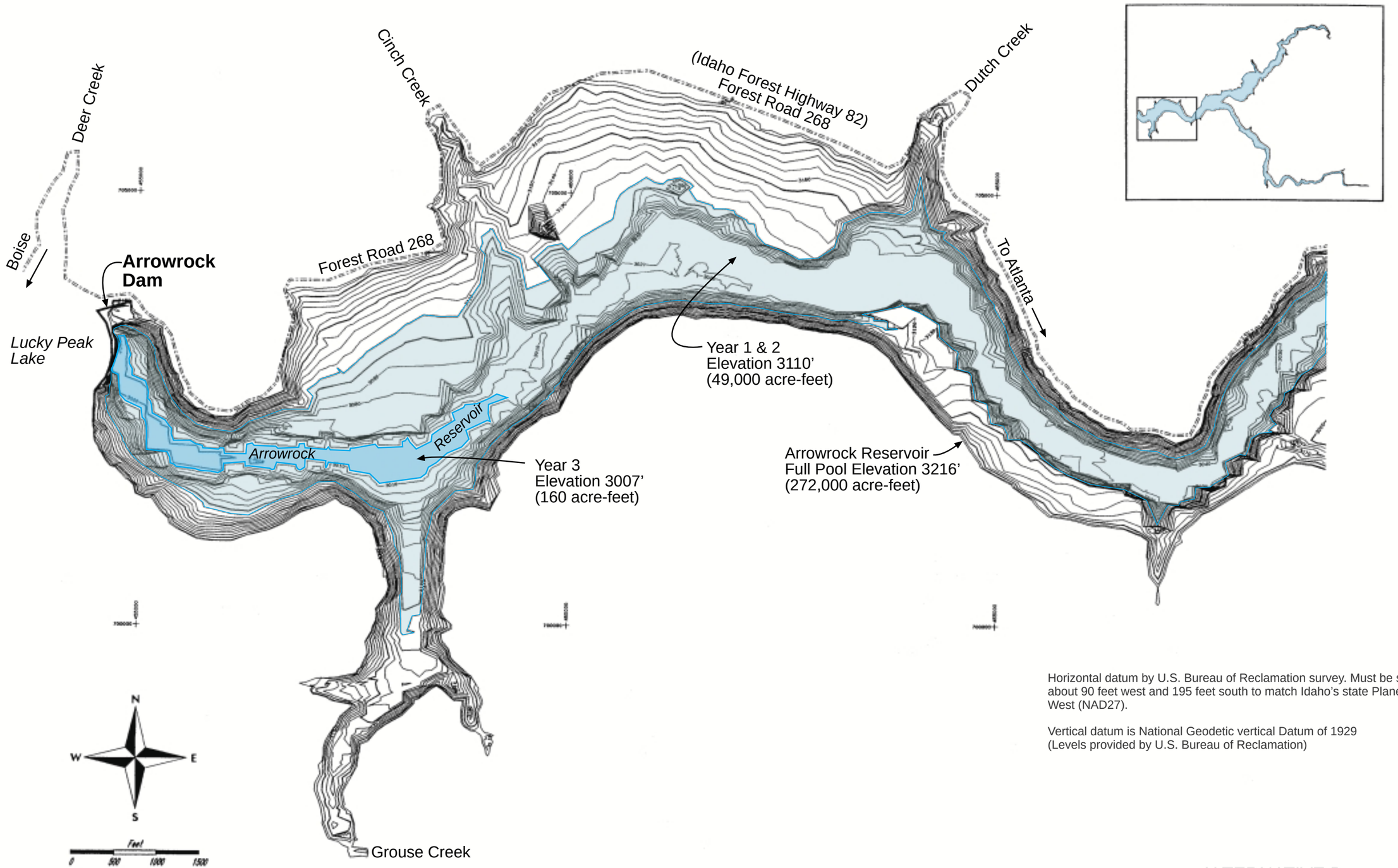
* These staging areas are dry during construction windows

Figure 2-8



ALTERNATIVE B
ARROWROCK DAM CROSS SECTION

Figure 2-9



Horizontal datum by U.S. Bureau of Reclamation survey. Must be shifted about 90 feet west and 195 feet south to match Idaho's state Plane Zone West (NAD27).

Vertical datum is National Geodetic vertical Datum of 1929
(Levels provided by U.S. Bureau of Reclamation)

ALTERNATIVE B

ARROWROCK RESERVOIR ELEVATIONS

Figure 2-10

Table 2-5. Construction Schedule for Alternative B (Shading Indicates Construction and Drawdown)[1]							
Year	Month						
	September	October	November	December	January	February	March - August
1	Mobilize for construction, excavate concrete for valves 1-3 and associated liners, place concrete for all gate structures and floor, and construct control house on downstream side of dam.						
	Arrowrock ≥ 3110 feet, Lucky Peak ≤ 3000 feet						
2	Install steel liners and clam shell gates, place additional concrete for gate structures and roof, construct access tower, and install mechanical, electrical, and hydraulic controls.						
	Arrowrock ≥ 3110 feet, Lucky Peak ≤ 3000 feet						
3	Remove Ensign valves, install bell mouth liners and bulk head guides, and complete the installation of controls.						
	Arrowrock – 3007 feet Lucky Peak ≤ 2962 feet						
[1]Lucky Peak elevations do not represent a drawdown but only a maximum elevation within normal operating parameters							

Staging, Materials, and Waste Materials

Construction staging, materials, and handling waste materials under Alternative B would be identical to that under Alternative A (see figure 2-8 for staging and waste material disposal areas).

Operation, Maintenance, and Replacement

Future OM&R would be identical with Alternative A.

Costs

The estimated cost for Alternative B is $14,600,000. The present worth is value of the capital cost is $12,500,000. Total for OM&R is estimated at $564,000 over a 50-year period. The shorter construction time, ease of access to the Ensign valves, elimination of stoplogs, and reduced hazard in the third construction year would decrease the total construction costs.

Alternatives Eliminated from Further Consideration

Several alternatives to replace the current Ensign valves with clamshell gates were identified and eliminated from further consideration. The differences among the alternatives are limited to the length and amount of drawdown and the method of providing dry working conditions.

Two-year construction periods, which would minimize the number of drawdowns for action alternatives, were examined. One alternative included a first year draw down of Lucky Peak to elevation 3010 (October through February) and a second year draw down of Arrowrock Reservoir to elevation 3026. The sluice gates would not be used. The other 2-year alternative included a first year draw down Lucky Peak to elevation 3010 (September through February) and a second year drawdown Arrowrock Reservoir to elevation 3026 (September through February). Sluice gates would be used in this second alternative. Both of the 2-year construction period alternatives were eliminated because a 2-year period was found to be of insufficient length to complete construction.

A primary concern expressed during scoping was the potential environmental effects of Arrowrock Reservoir drawdown needed to accomplish the work. Based on that input, Reclamation investigated methods of construction that would not require reservoir drawdown below normal fluctuation levels or would minimize drawdown. These alternatives focused on ways to reduce drawdown and to increase Arrowrock pool size during construction.

Reclamation formed a VE team in 1999 to evaluate costs, time frames, and various factors for achieving construction without drawdown of Arrowrock Reservoir. The value study team compared the construction scenario presented in the scoping process with three construction options that would require less or no drawdown through use of (1) a steel **cofferdam**, (2) an upstream pressure vessel, or (3) construction by divers (Reclamation, 1999b).

The upstream pressure vessel was eliminated because costs would be extravagant, in excess of three times the cost of the original construction concept. The cofferdam option and the dive option seemed feasible on first evaluation so were carried forwarded for further evaluation of constructability. In a Constructability Review (Reclamation 1999c), the cofferdam was determined to be infeasible based on (1) insufficient space to install the cofferdam within the trashrack compartment and still provide space to remove the components of the ensign valve structure, (2) problems in anchoring and sealing a larger coffer dam not supported within the trashrack structure, (3) difficult access by divers needed to properly seal the lower portion of the cofferdam, (4) a limited work area and leakage that would make high quality work difficult, (5) safety and rescue problems for workers related to the confined space and difficult access, and (6) costs presented in the Value Engineering Report (Reclamation 1999b) that did not account for many of the unknowns related to problems listed above and the unique nature of the work. Actual costs could be many millions of dollars more. A means of safely enlarging the size of the cofferdam to accommodate removal of the valves was not found. The ability to seal the cofferdam to the face of the dam appears limited with the potential for failure and a high level of risk to workers within the cofferdam during construction.

The Value Engineering Report (Reclamation 1999b) determined that underwater construction by divers on the upstream face of the dam would be technically feasible but it would (1) be costlier, (2) potentially require a second construction season for upstream work, (3) subject divers to safety risks while working near adjacent operating outlets, and (4) reduce the discharge capacity of adjacent outlets due to diver safety requiring either a delay or use of sluice gates during high inflows. Further evaluation determined that the costs estimated in the Value Engineering Report did not account for the many unknowns and risks involved and the proposal was eliminated as a feasible means of accomplishing the work (Reclamation 2000).

It is important to note that Lucky Peak Lake would need to be at or lower than 3000 feet elevation to allow access to the downstream side of Arrowrock Dam under all alternatives.

Information on technical concepts, including numbers and kinds of valves and various construction techniques, identified during the planning process are summarized in appendix B. This appendix identifies the reasoning for carrying some elements forward and for eliminating other elements from further consideration.

Summary of Alternatives

The No Action Alternative requires drawdown of Arrowrock Reservoir in years 1 and 3 and every 6 years thereafter for the life of the project. In contrast, Alternatives A and B require only one drawdown of Arrowrock Reservoir during the life of the project; that drawdown would be in year 3 of the construction period. In addition, the drawdown of Arrowrock Reservoir under Alternative A would be no longer than that for year 3 of the No Action Alternative, and drawdown under Alternative B would be much shorter.

Modernizing the outlet works by installing new clamshell gates and mechanical equipment under Alternatives A and B would lower long-term maintenance costs and the risk of emergency situations due to failure of the old equipment. In contrast, Reclamation cannot with confidence state that overhaul of the existing 80-year old valves would result in operation free of malfunctions as we do not know what type of failures may occur with such old equipment.

Table 2-6 summarizes physical features and Arrowrock Reservoir drawdowns of the alternatives and table 2-7 presents a summary of impacts.

Table 2-6. Summary of Alternative Facilities, Reservoir Elevations and Costs			
Item	Alternative		
	No Action	A (Preferred)	B
Facilities			
Spillway	No change	No change	No change
Upper row of Ensign valves	Retained	Abandoned but left in place	Abandoned but left in place
Lower row of Ensign valves	Retained	Replaced with clamshell gates	Replaced with clamshell gates
Sluice gates	Retained	Abandoned but left in place	Abandoned but left in place
Construction or Major Maintenance			
50 year period	9 years (Years 1, 3, and every sixth year thereafter)	3 construction seasons (parts of 4 water years)	3 construction seasons (parts of 4 water years)
Scheduled Arrowrock Reservoir Elevations (Elevations reflect Water/Reservoir Operations Modeling)			
Total drawdowns (50-year period)	9	1	1
Year 1 (elevation)	3007 feet for 2 months	>3110 feet	>3110 feet
Year 2 (elevation)	Normal operation	>3110 feet	>3110 feet
Year 3 (elevation)	2975 feet for 5 months	3027 feet for 5½ months	3007 feet for 9 weeks
Year 9, 21, 33, 45 (elevation)	3007 feet for 5 months	Normal operation	Normal operation
Years 15, 27, 39 (elevation)	2975 feet for 5 months	Normal operation	Normal operation
Scheduled Lucky Peak Lake Elevations (Elevations reflect Water/Reservoir Operations Modeling)			
Total drawdowns (50-year period)	9	3	3
Year 1 (elevation)	2962 feet for 3 months (November 7-December 31)	3000 feet for 5½ months (September 15-March 1)	3000 feet for 5½ months (September 15-March 1)
Year 2 (elevation)	Normal operation	3000 feet for 5½ months (September 15-March 1)	3000 feet for 5½ months (September 15-March 1)
Year 3 (elevation)	2962 feet for 5 months (October 1-March 1)	2962 feet for 5½ months (September 15-March 1)	2962 feet for 9 weeks (beginning September 1)
Year 9, 15, 21, 27, 33, 39,45 (elevation)	2962 feet for 5 months (October 1-March 1)	Normal operation	Normal operation
Cost			
Capital (present worth)	$11,000,000	$12,900,000	<$12,500,000
Capital (50-year life cycle)	$34,300,000	$15,000,000	< $14,600,000
Operation, maintenance, and replacement (50-year total)	$1,000,000	$564,000	$564,000

Table 2-7. Summary of Impacts			
	Alternative		
Item	No Action	A (Preferred)	B
Water Quality			
Arrowrock Reservoir			
Years affected	9 of 50 years	1 year	1 year
Pool size	0 and 160 acre-feet in alternate drawdowns	1,500 acre-feet	160 acre-feet
Sediment outflow	<520 to 1,250 acre-feet (each drawdown)	0 to 10.5 acre-feet	Up to 1,250 acre-feet
Turbidity and total suspended solids	Temporary increase (each drawdown)	Temporary increase (less than No Action and B)	Temporary increase for shorter duration than No Action and A. (less than No Action)
Lucky Peak Lake			
Sediment inflow	<520 to 1,250 acre-feet in 9 of 50 years	0 to 10.5 acre-feet in 1 year	Up to 1,250 acre-feet in 1 year
Sediment accumulation	<345 to 830 acre-feet in 9 of 50 years	0 to 7.5 acre-feet in 1 year	Up to 830 acre-feet in 1 year
Turbidity and total suspended solids	Increase concentrations	Low levels unless sluice gates are operated	Increased concentrations
Total dissolved gases	Continued occasional elevated levels	Temporary increase in two construction seasons, long-term decrease	
Lower Boise River			
Main stem–Turbidity and total suspended sediment/solids	Exceed turbidity standard and Total Maximum Daily Load targets in 9 of 50 years	Turbidity standard and Total Maximum Daily Load target unlikely to be exceeded. May exceed during 1 year if sluice gates are used	Exceed turbidity standard and Total Maximum Daily Load targets in 1 year (shorter duration than No Action)
Lake Lowell–Turbidity and total suspended solids	Increased in 9 of 50 years	Probably no increase	Increase in 1 year
Anderson Ranch Reservoir, South Fork Boise River, and other Stream Reaches – No Impacts			

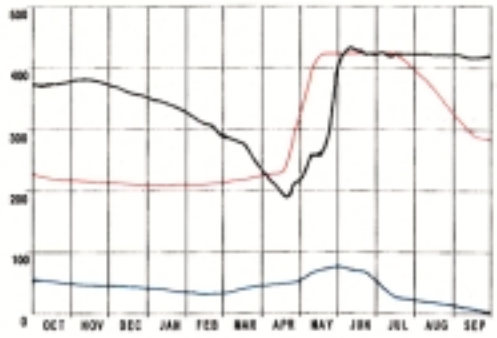
Table 2-7. Summary of Impacts			
	Alternative		
Item	No Action	A (Preferred)	B
Endangered and Threatened Species			
Bull Trout			
Mortality Risk			
Arrowrock Reservoir	High	Moderate	High
Lucky Peak Lake	Low[1]	Low[1]	Low[1]
Entrainment			
Arrowrock Reservoir	High	High (less than No Action)	High (less than No Action, greater than A)
Lucky Peak Lake	Low	Low	Low
Food Supply			
Arrowrock Reservoir	Total loss, 1-4 year recovery	Near total loss, 1-4 year recovery	Total loss, 1-4 year recovery
Lucky Peak Lake	Short term reduction	Minimal impact	Short term reduction
Bald Eagles			
Arrowrock Nesting Pair			
Food supply	Periodic short-term and long-term reduction	Short-term reduction	Short-term reduction
Productivity	Potential loss in 9 of 50 years	Potential loss (less than No Action and B)	Potential loss (less than No Action, greater than A)
Wintering Eagles			
Foraging opportunity	Degraded in some areas, enhanced in others (9 of 50 years)	Degraded in some areas, enhanced in others (less effect than No Action and B)	Degraded in some areas, enhanced in others (less effect than No Action, greater than A)
Gray wolf	No effect		
Ute ladies'-tresses	No effect		
Snake River salmon and steelhead	No effect		
Other Game Fish			
Arrowrock Reservoir (risk of loss)	Significant for 2-3 years of every 6 year period	Significant for 2-3 years	Significant for 2-3 years (greater than A)
Lucky Peak Lake	Significant impacts from turbidity, 1 year of every 6-year period	Likely no effect	Significant impacts from turbidity for 1 year

Table 2-7. Summary of Impacts			
	Alternative		
Item	No Action	A (Preferred)	B
Vegetation and Wildlife			
Waterfowl (loss of open water habitat)	Fall and winter of 9 of 50 years	Fall and winter of 1 year	Fall of 1 year
Shorebirds (foraging opportunity)	Enhanced in fall of 9 of 50 years	Enhanced in fall of 1 year	Enhanced in fall of 1 year
Fish eating species (foraging opportunity)	Hampered due to turbidity increase in 9 of 50 years	Hampered in 1 year (less effect than No Action and B)	Hampered in 1 year (less effect than No Action)
Vegetation	Minor clearing of upland areas for construction staging		
Irrigation Water Supply Shortage[2]			
Number of times	9 in 50 years	1 year	1 year
4-year Cumulative Shortage – Total Shortages			
Wet period	65,200 acre-feet	None	None
Average period	121,600 acre-feet	55,000 acre-feet	None
Dry period	550,100 acre-feet	478,700 acre-feet	403,300 acre-feet
4-year Cumulative Shortage – Specifically Due to the Alternatives			
Wet period	Not applicable	0 acre-feet	0 acre-feet
Average period	Not applicable	55,000 acre-feet	0 acre-feet
Dry period	Not applicable	81,000 acre-feet	5,600 acre-feet
Recreation Effects			
Arrowrock Reservoir (recreation-days)	Minimal loss in 9 of 50 years	Slight increase in 2 years, slight loss in 1 year	Slight increase in 2 years, slight loss in 1 year
Lucky Peak Lake (recreation-days)	Minimal loss in 9 of 50 years	Slight loss in 3 years	Minor loss in 2 years -103,100 in 1 year
Lower Boise River (recreation-days)	None	Significant loss in 1 year -43,750 in an average to dry year -175,000 in a wet year	Significant loss in 1 year -175,000 in a wet, average, or dry year
Anderson Ranch	Slight increase in recreation use		
South Fork Boise River	No change in recreation use		

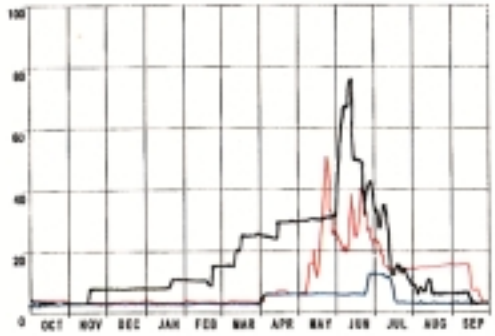
Table 2-7. Summary of Impacts			
	Alternative		
Item	No Action	A (Preferred)	B
Economic Effects			
Irrigation	Minor impacts in 9 of 50 years (not meaningful to calculate)	Minor impact in 1 year (less than No Action)	Very minor impact in 1 year (less than No Action and Alternative A)
Hydropower (4-year period) – Lucky Peak and Anderson Ranch Powerplants			
Generation	1,772,585 megawatt-hours	1,749,642 megawatt-hours	1,744,015 megawatt-hours
Economic value Low High	 $45.6 million $74.4 million	 $44.9 million $73.1 million	 $44.5 million $72.6 million
Incremental value (compared to No Action) High Low	 not applicable not applicable	 -$740,000 -$1,285,000	 -$1,115,000 -$1,786,000
Recreation			
Arrowrock Reservoir	Very minor negative impact in late season in 9 of 50 years	Slight positive impact in 2 years and slight negative impact in 1 year	Slight positive impact in 2 years and slight negative impact in 1 year
Lucky Peak Lake	Minimal negative impact in 9 of 50 years	Minimal negative impact	Significant benefit loss of $3,702,900 due to reduced access to facilities
Lower Boise River	No effect under average water conditions. Negative effect during a wet year	Benefit loss of $314,100 in an average or dry year Benefit loss of $1,256,500 in a wet year	Benefit loss of $1,256,500 in an average or wet year
Anderson Ranch Reservoir	Slight positive impact to late season recreation use compared to normal operations due to higher reservoir elevation		
South Fork Boise River	No effect to slight positive impact		
Total recreation monetary loss	None	-$314,100 in an average or dry year -$1,256,500 in a wet year	-$4,959,600
Financial Effects (Capital Costs)			
United States obligation (54 percent of costs)	$18. 4 million over 50-year life	$8.1 million	$7.9 million
Arrowrock Reservoir spaceholder obligation (46 percent of costs)	$15.6 million paid over 50-year project life	$6.9 million paid through construction period	$6.7 million paid through construction period

Figure 3-1 —Typical Content and Outflow of Boise Project Reservoirs

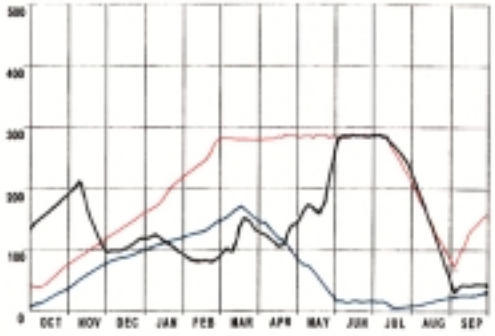
Contents of Anderson Ranch Reservoir
(1,000 acre-feet)



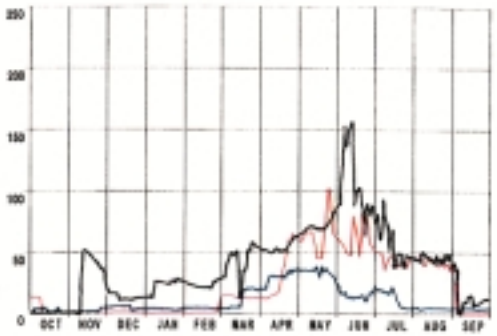
Outflow of Anderson Ranch Dam
(100 cubic feet per second)



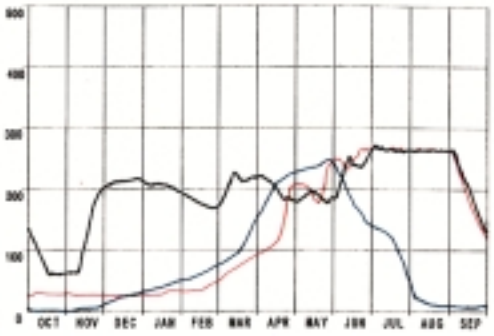
Contents of Arrowrock Reservoir
(1,000 acre-feet)



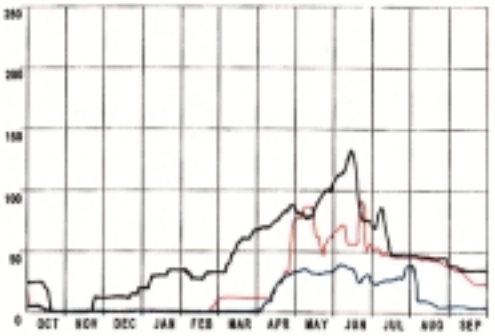
Outflow of Arrowrock Dam
(100 cubic feet per second)



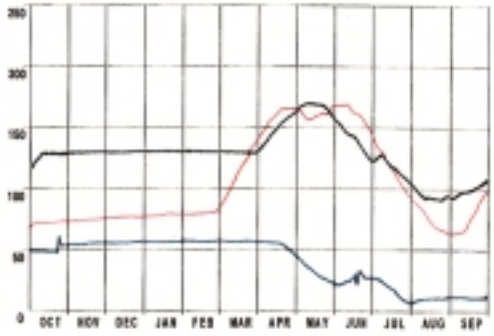
Contents of Lucky Peak Reservoir
(1,000 acre-feet)



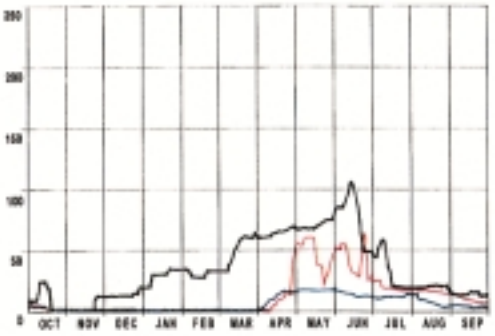
Outflow of Lucky Peak Dam
(100 cubic feet per second)



Contents of Lake Lowell (Deer Flat Dams)
(1,000 acre-feet)



Outflow of Boise R. Diversion Dam
(100 cubic feet per second)



1983 (Good water supply) 1980 (Average water supply) 1992 (Low water supply)

Table 2-7. Summary of Impacts			
	Alternative		
Item	No Action	A (Preferred)	B
Effects on Cultural Resources			
Archeological Sites/Traditional Cultural Properties			
Potential for physical disturbance due to erosion	Yes	Yes (less than for No Action and B)	Yes (less than for No Action)
Potential for looting or vandalism	Yes	Yes	Yes
Historic Dam	Minor, non-visible impact	Removal of original elements and alteration of appearance. Largely mitigated	
Effects on Indian Sacred Sites			
Potential for physical disturbance due to erosion	Yes	Yes (less than for No Action and B)	Yes (less than for No Action)
Potential for looting or vandalism	Yes	Yes	Yes
Effects on Indian Trust Assets			
Right to hunt and fish	No Effect		
Cumulative Effects			
Resources	No significant cumulative effect to any resource category		

[1]Higher risk for fish near Arrowrock Dam due to higher turbidity levels.
[2]Total annual diversion total by water condition are: wet period – 1,300,000 acre-feet; average period – 1,550,000 acre-feet; and dry period – 804,000 acre-feet.

3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Introduction

This chapter describes the affected environment and evaluates the environmental consequences of implementing each of the alternatives described in chapter 2. The level and depth of the environmental analysis corresponds to the context and intensity of the impacts anticipated for each environmental component. Where the alternatives would have the same impacts on an environmental component, the analysis is presented once and summarized or referenced in subsequent analyses to eliminate redundancy.

The area of analysis for this EIS includes the following components of the Boise River system: Anderson Ranch Reservoir and the South Fork Boise River downstream, Arrowrock Reservoir, Lucky Peak Lake, Lake Lowell, and the main stem Boise River downstream through the city of Boise.

Discussions are arranged by resource in the following order:

- Water/Reservoir Operations
- Water Quality
- Fish
- Vegetation and Wildlife
- **Threatened and Endangered Species**
- Recreation
- Economics
- **Cultural Resources**
- Indian **Sacred Sites**
- Indian Trust Assets

The resource discussions are split into two sections– relevant resources (affected environment) and the effects of the alternatives (environmental consequences). Within each section, the discussion of water, water quality, fish, vegetation and wildlife, and recreation are primarily arranged by river reach (from the reach likely to be most affected to the reach likely to be least affected) in the following order:

- Arrowrock Reservoir
- Lucky Peak Lake
- Lower Boise River and Lake Lowell
- Anderson Ranch Reservoir
- South Fork Boise River downstream of Anderson Ranch Dam

Other resource discussions have alternate divisions– threatened and endangered species is divided by species, economics is divided by economic aspects, and cultural resources, Indian sacred sites, and Indian trust assets (ITA's) are limited to a single reservoir.

Resources Not Affected by the Alternatives

None of the alternatives and associated actions would affect regional or local climates, topography, or social conditions in the area. Air quality and noise would have extremely minor effects but would not rise to the level for further analysis. The following also would not be affected:

- Winter flooding probability downstream of Lucky Peak Dam
- Salmon flow augmentation water provided from the Snake River basin
- **Wetlands**
- Environmental Justice

Salmon flow augmentation is a priority consideration for Reclamation and operations assure that the commitment is met in all years. Although operations of the Boise River/reservoir system and the Boise Project affect wetlands, reservoir/river operations would be within normal historical parameters and would neither create nor destroy wetlands. Executive Order 12898 on environmental justice directs Federal agencies to identify and address disproportionately high and adverse impacts of their action to low income or minority populations. Although such populations are found in the area and use its resources, none of the alternatives would disproportionately affect such populations.

Water/Reservoir Operations

Affected Environment

This overview briefly summarizes the facilities of the Boise River/storage system and the operation of those facilities. More detailed accounts of facilities and operations can be found in Reclamation (1996 and 1997).

River/Reservoir System

The Boise River basin upstream from the city of Boise is a rugged mountainous area with a very low population. Through the city of Boise and downstream, the river valley widens into an area of rolling hills and flat plains that contains about one-third of the population of Idaho.

Three forks of the Boise River–the North Fork, Middle Fork, and South Fork–are located to the east of the city of Boise (see Location Map). The Middle Fork (considered to be the main stem) flows generally southwest to be joined by the North Fork which also flows southwest. Further southwest, the South Fork flowing from the east joins the main stem. Mores Creek and its major tributary, Grimes Creek, flow generally south and drain an area to the west of the three forks of the Boise River. Mores Creek joins the Boise River main stem about 12 river miles upstream from the city of Boise. The Boise River continues west through the city of Boise and past the edge of the city of Caldwell to join the Snake River at the Oregon-Idaho border and at Snake River mile 392.3. The Boise River drains about 4,130 square miles in parts of Ada, Boise, Camas, Canyon, Gem, Elmore, and Payette Counties. Table 3-1 summarizes river mile points for selected features along the Boise River.

Table 3-1. Modified River Mile Index for the Boise River	
River Mile[1]	**Feature**
0.0	Mouth at Snake River (at Snake River mile 392.3)
14.0	Notus, Idaho
20.3	Indian Creek
33.9	Star, Idaho
38.0	Eagle Island (lower end)
46.4	Eagle Island (upper end)
48.0	Glenwood Bridge (Boise)
53.7	Broadway Bridge (Boise)
58.3	Barber Road bridge (Barber Park)
59.0	Barber Dam
61.4	Boise River Diversion Dam (New York Canal)
64.0	Lucky Peak Dam
70.5	Mores Creek
75.4	Arrowrock Dam
79.4	South Fork Boise River 0.0 Mouth 43.5 Anderson Ranch Dam
97.3	North Fork Boise River
97.3	Middle Fork (considered to be the main stem)
129.0	Atlanta, Idaho
[1]River miles are measured starting at the mouth and moving upstream in the center of the stream	

Most of the precipitation that falls on the watershed above Lucky Peak Lake (about 2,680 square miles) is in the form of snow. Snowmelt in the spring causes high flows as the weather warms. Peak inflow to Arrowrock and Anderson Ranch Reservoirs is usually between April 15 and June 15. Records for 1895 through 1980 show an average annual runoff of 2,040,000 acre-feet, with about 78 percent of the runoff occurring from March through July (Corps, 1985). From August through February, natural flows are generally low; however, high flows sometimes occur during winter rainstorms, especially if there are warm rains on snowpack or frozen ground. Winter storm events are mostly of short duration, producing a relatively low volume of flow.

The onstream facilities of concern in this EIS are (1) Arrowrock Dam and Reservoir and Anderson Ranch Dam and Reservoir constructed as part of the Arrowrock Division of the Boise Project and (2) Lucky Peak Dam and Lake constructed by the Corps.

Lake Lowell, an off-stream reservoir constructed south of Nampa as part of the Boise Project, has a total capacity of 173,000 acre-feet. It is filled via the New York Canal which heads at Boise River Diversion Dam (RM 61.4). Because the reservoir has the oldest water rights, filling of Lake Lowell is a priority.

Arrowrock Dam and Reservoir

Arrowrock Dam, constructed in 1915, is located on the Boise River at RM 75.4, about 17 river miles upstream from city of Boise, Idaho (see figure 1-2). The concrete thick arch structure has a structural height of 350 feet and a crest length of 1,150 feet. The crest is 21.5 feet wide and includes a roadway providing access across the dam.

Arrowrock Reservoir is contained by a moderately deep canyon carved by the Boise River. At full pool, water is backed up past the confluence of the Middle and South Forks, so the reservoir is shaped like the letter "Y." The longest reservoir arm is about 17 miles long. At full pool the reservoir is approximately 250 feet deep near the dam and has a surface of approximately 3,100 **acres**.

Prior to 1997, the storage capacity of Arrowrock was estimated at 286,600 acre-feet. In 1997, the reservoir was resurveyed to estimate storage losses due to sedimentation, and new area/capacity figures were computed. The capacity of Arrowrock Reservoir at full pool elevation is 272,000 acre-feet based on the new data. This amounts to a loss of about 14,600 acre-feet of storage over a period of about 50 years.

Lucky Peak Dam and Lake

Lucky Peak Dam, completed by the Corps in 1957 for flood control and irrigation, is located on the Boise River about 11.4 river miles downstream from Arrowrock Dam and is only 8 air miles east of Boise (see Location map). It is the dam furthest downstream with the ability to control riverflow. The dam is a 1,700-foot- long, rolled earth and gravel structure 340 feet high. Reclamation markets water in Lucky Peak Lake for irrigation. In 1988, four irrigation districts constructed a 3-unit power plant at Lucky Peak Dam under a FERC license. The powerplant has a total capacity of 101,250 kilowatts (kW) and is operated Seattle City Light, a department of the city of Seattle under contract to the four irrigation districts. In addition to the powerplant, Lucky Peak Dam also has a 23-foot-diameter outlet tunnel and an emergency spillway.

At full pool, Lucky Peak Lake contains 264,400 acre-feet of active storage, has a water surface area of 2,737 acres, is about 11 miles long, and is 317 feet deep near the dam. At higher elevations, Lucky Peak Lake backs-up against Arrowrock Dam. At the full pool elevation of 3055 feet Lucky Peak Lake, the surface is 160 feet above the toe of Arrowrock Dam, nearly 90 feet above the sluice gates and about 35 feet above the lower Ensign valves.

Anderson Ranch Dam and Reservoir

Anderson Ranch Dam, at river mile 43.5 on the South Fork Boise River and about 47.5 river miles upstream from Arrowrock Dam, was completed by Reclamation in 1950 as part of the Boise Project (see Location map). The dam is a zoned earthfill structure 456 feet high. Anderson Ranch Powerplant, a Reclamation facility, has two generators with a total capacity of 40,000 kW. A spillway controlled by two radial gates is located on the left abutment of the dam.

Anderson Ranch Reservoir is the largest of the three Boise River reservoirs with an active capacity of 423,200 acre-feet and a water surface area of over 4,700 acres.

Reservoir Data Summary

Table 3-2 summarizes active storage, inactive storage, and dead storage volumes and associated water surface elevations and areas for the three reservoirs discussed in this EIS.

Table 3-2. Data for Boise River Reservoirs

Item	Reservoir		
	Anderson Ranch	Arrowrock	Lucky Peak
Storage (acre-feet)			
Active	423,200	[1]272,000	264,400
Inactive	41,000	0	28,767
Dead	29,000	0	0
Total	493,200	272,000	293,167
Water surface elevations (feet)			
Top of active storage	4196	3216	3055
Top of inactive storage	4039.6	-	2905
Top of dead storage	3992	-	-
Water surface area (acres)			
Top of active storage	4,740	3,100	2,737
Top of inactive storage	1,095	-	796
Top of dead storage	639	-	-

[1]Based on a 1997 sedimentation study; the figure that is shown in most references is 286,600

Storage System Active Space

Reclamation was issued water rights by the State of Idaho for all storage in Arrowrock and Anderson Ranch Reservoirs and Lucky Peak Lake. Reclamation markets storage in Lucky Peak Lake under the authority of the Flood Control Act of 1944. Repayment contracts for the two Reclamation facilities are in the form of spaceholder contracts. These contracts, primarily with irrigation districts and water companies, are in perpetuity and account for construction cost and annual OM&R cost. Contract language differs for each reservoir but generally provides for the distribution of water that accumulates in the contract space, with the amount prorated when reservoirs are not filled. Contracts for storage water in Lucky Peak Lake are 40-year service

contracts that may be renewed; the first service contracts were issued in the 1960's and will be expiring beginning in 2004.

Essentially all of the active storage capacity of Arrowrock and Anderson Ranch Reservoirs have been contracted, and all but a few thousand acre-feet are contracted to irrigation entities; a small amount has been contracted for municipal and industrial (M&I) water supply. In contrast, less than one-third of the storage in Lucky Peak Lake has been contracted. The remaining space has been reacquired and formally assigned to salmon flow augmentation or is reserved for **instream flow** maintenance. Table 3-3 summarizes contracted and assigned space in the three reservoirs.

Table 3-3. Boise River Reservoir Active Space (Acre-Feet)

Reservoir	Contracted Space		Formally Assigned Space		Total Active Capacity
	Irrigation	M&I	Salmon Flow Augmentation	Winter Streamflows and Other Uses	
Arrowrock	[1]286,600	0	0	0	[1]286,600
Anderson Ranch	418,000	4,800	0	400	423,200
Lucky Peak	71,018	0	40,932	152,420	264,370
Total	775,618	4,800	40,932	152,820	974,170

[1]286,600 reflects the amount in the contracts. Current estimate of active space is 272,200 acre-feet

A water rights accounting is maintained to ensure that, regardless of where water is physically stored, the storage and use of water are properly accounted to the appropriate rights and spaceholders.

Reservoir System Operations

General System Operation

The three Boise River storage reservoirs are operated as a system to meet irrigation water supply, flood control, instream flows, power generation, and recreation goals. System operations are outlined in the Water Control Manual (Corps, 1985) which was developed jointly by Reclamation and the Corps in consultation with the Idaho Department of Water Resources (IDWR), the Boise River Watermaster, and the Boise Project Board of Control. Informal agreements developed since 1985 cover some operations, especially those related to salmon flow augmentation and streamflow maintenance.

Reservoir operations are conducted over a “water year” from October 1 to September 30. There are three general operating seasons based on climatological patterns, runoff, and irrigation demand:

- Maintenance Period (November through March) - Stored water is carried over from previous year to the extent that flood control and releases for streamflows and natural flow rights allow.

- Flood Control and Refill (April through July) - Outflow and storage are adjusted based on runoff forecasts to provide space for flood control and ensure reservoir refill. Irrigation season begins in April, and part of salmon flow releases are made in July.

- Drawdown Period (August through October) - Storage is released for irrigation, and salmon flow augmentation releases are completed.

Reservoir operations can vary greatly from year to year depending on water supply and other factors so that the above schedule is shifted to earlier or later months. For example, flood control operations may begin as early as January in years with high runoff forecasts such as 1996 and 1997. During dry years, reservoir drawdown may begin as early as April.

System Flood Control Operations

The reservoir system is operated under formal flood control rules. Runoff forecasts for the general operation of the Boise River are prepared by Reclamation's Pacific Northwest Regional Office in Boise and the Corps who then jointly arrive at a single coordinated forecast. That forecast is used with **rule curves** to identify the required amount of flood control space.

The rule curves in the Water Control Manual include (1) a winter minimum system space requirement designed to protect against a rain-on-snow event and (2) a spring runoff space requirement that is tied to monthly runoff forecasts. From November 1 through December 31, the winter requirement is for a minimum system space of 300,000 acre-feet, about one-third of the total active system storage of 960,000 acre-feet, to be distributed among the three reservoirs. From January 1 to March 1, the minimum system space requirement is 150,000 acre-feet and at least 55 percent of the winter space must be in Arrowrock Reservoir and Lucky Peak Lake.

Flood control operations from January 1 through the end of the flood control season (April 15 to July 31) are based on a forecast of runoff volumes with the objective of providing sufficient reservoir space to limit streamflow at Glenwood Bridge to 6,500 **cubic feet per second** (cfs). In order to meet the space requirements, there is sometimes a need for significant releases from one or more of the three reservoirs during late winter or spring. During wet years, water may be released at a rate of up to 6,500 cfs before April 1 and for an extended period. Release rates from Lucky Peak Dam to provide flood control space have ranged up to 13,200 cfs (9,560 cfs at Glenwood Bridge). During consecutive dry years such as occurred in the late 1980's and early 1990's, little or no flood control releases may be necessary. Flood control releases are balanced against reservoir refill for irrigation water supply.

System Irrigation Operations

Water rights for irrigation are the primary basis for reservoir releases during the irrigation season, which is considered to be from April 1 to November 1. Irrigation diversions usually begin about April 15 and end by October 15 with the highest demand in July. In a normal or above normal water year, early irrigation diversions are concurrent with late flood control releases. Storage drafts begin when the natural flow drops below the irrigation demand of about 4,300 cfs, signaling the end of flood control operations.

System shortages affect contractors for Lucky Peak Lake space because the storage right for Lucky Peak Lake is junior to storage rights for Arrowrock and Anderson Ranch Reservoirs. If the system fails to fill due to flood control operations and the shortage is 60,000 acre-feet or less, shortages are made up from uncontracted space in Lucky Peak Lake. If the shortage is not related to flood control operations or exceeds 60,000 acre-feet, shortages are shared among the Lucky Peak Lake space holders by prorating the water supply. The Boise River Watermaster is responsible for irrigation operations, ordering releases for irrigation, and water accounting, even during flood control operations. During the irrigation season, the Watermaster determines the amount of water that must be released from Lucky Peak Dam. Reclamation operators transfer water from Anderson Ranch and Arrowrock Reservoirs to Lucky Peak Lake as necessary to provide this water.

The largest irrigation diversions on the Boise River are the New York and Ridenbaugh Canals, located just upstream of Boise. Other significant diversions are the Settlers and Farmers Union Canals near Boise, the Phyllis and Middleton Canals near Eagle Island, and Riverside and Sebree Canals near Caldwell. There are many other smaller diversions, as well as substantial irrigation return flow to the river reach between the city of Boise and the confluence with the Snake River.

Reclamation typically drafts Arrowrock Reservoir first, beginning in June or July and lasting until the first of September, or until the reservoir reaches elevation 3078 feet, to maintain water levels in Anderson Ranch Reservoir and in Lucky Peak Lake for recreation. Drafts from Anderson Ranch for irrigation may be made during the same time period and are maintained at powerplant capacity (1,600 cfs) through the summer irrigation season until September. Under current operations, the lowest pool for Arrowrock Reservoir is normally reached by Labor Day. In contrast, Lucky Peak Lake is held full throughout the summer and the Labor Day holiday to benefit recreation. After Labor Day, irrigation demands are met primarily by drafting Lucky Peak Lake which results in a fairly rapid drawdown until mid-October when irrigation demand ceases. At the end of the irrigation season, the elevation of Lucky Peak Lake is normally still higher than the toe of Arrowrock Dam. Reservoir elevations and streamflows are shown in figure 3-1.

System Winter Minimum Flows and Reservoir Contents

Minimum flow releases from Anderson Ranch Dam for fishery maintenance are 300 cfs from September 16 to March 31 and 600 cfs from April 1 to September 15 (Reclamation, 1997). However, these targets are not always met in dry years. Winter releases from Arrowrock Dam average 300 cfs but at a minimum will pass inflow. The target minimum flow release from Lucky Peak Dam is 150 cfs which includes 80 cfs from space assigned to streamflow maintenance, 70 cfs from space assigned to the IDFG, and other storage (Reclamation 1997). Winter releases from Lucky Peak Lake have been a minimum of 240 cfs in recent years of abundant water.

Unofficial minimum reservoir pools are: 70,000 acre-feet for Anderson Ranch Reservoir, 28,700 acre-feet for Arrowrock Reservoir, and 28,730 acre-feet for Lucky Peak Lake (Reclamation, 1996). The Anderson Ranch and Lucky Peak pools are based on reservoir content at the top of inactive reservoir storage. The Arrowrock pool is based on a pool elevation of 3078 feet. Recent sedimentation studies indicate that at elevation 3078 feet, the pool content would be 19,100 acre-feet.

Salmon Flow Augmentation

Since 1991, Reclamation has agreed to annually provide 427,000 acre-feet from the upper Snake River for flow augmentation in the lower Snake River and Columbia River to aid migrating salmon smolts. Release was approved through 2000 and is expected to continue in the future. Most of the water for flow augmentation has been acquired on a year-to-year basis through water rentals and from uncontracted Reclamation storage in the upper Snake, Boise, and Payette River basins. Less than 10 percent of the water has come from the Boise River.

Water acquisition from the Boise River for flow augmentation has been primarily from uncontracted storage in Lucky Peak Lake and in two dry years from inactive space in Anderson Ranch reservoir. As of this writing, Reclamation has reacquired 40,932 acre-feet of space in Lucky Peak Lake for flow augmentation (see table 3-3). All of the water used for flow augmentation passes through the state water bank and is subject to its rules. The Boise River Water Rental Pool has specific water rules for payment and for refill of space from water sold to the rental pool.

In recent years, flow of about 400 cfs have been released in July and August from the Boise River system for salmon flow augmentation; this flow is in addition to irrigation releases. Table 3-4 summarizes the volume of water released for salmon flow augmentation from 1993-1999.

Table 3-4. Source of Boise River Water for Salmon Flow Augmentation (1993-1999)							
	Year and Amount (Acre-Feet)						
Source	1993	1994	1995	1996	1997	1998	1999
Anderson Ranch powerhead (inactive space)	20,000	10,950	0	0	0	0	0
Anderson Ranch uncontracted space	0	0	3,000	3,000	3,000	0	0
Lucky Peak uncontracted space	3,000	25,000	22,000	35,000	35,000	40,932	40,932
Rental pool	0	0	2,000	0	2,000	0	0
Total Boise River	23,000	35,950	27,000	38,000	40,000	40,932	40,932
Total Upper Snake River basin	424,588	428,112	427,235	422,641	437,281	427,000	427,000
Release date: 1993 (7/13-8/7); 1994 (7/5-8/18); 1995 (7/17-8/20); 1996 (7/12-8/26); 1997 (7/14-8/26); 1998 (7/7-8/28); 1999 (7/4-8/29)							

Operation of Individual Facilities

Operation of individual dams are covered in their respective SOP's. These manuals provide a wide range of information on the purpose and function of the facility; how the dam is to be operated; specific features including maintenance, notification and other procedures in the event of an emergency, reservoir allocations; etc. The intent of the SOP is to provide sufficient information for a dam operator to handle most situations and to notify the appropriate authority in unusual circumstances.

Arrowrock Dam Operation

In normal and high water years, Arrowrock Reservoir is drafted for irrigation beginning in July. In drought years, the reservoir may not fill and the draft for irrigation may begin in April (see figure 3-1). The reservoir is drafted through the summer to Labor Day or until the elevation reaches 3078 feet; after that, Lucky Peak Lake is used to meet irrigation demand.

Regulation of discharge is usually controlled by the drum gates or the Ensign valves; not by both gates and valves except during the period of change. In the past, when the reservoir was nearly full, discharge through the spillway by regulating the drum gates was generally preferred. Recently, in response to the bull trout entrainment concerns, Reclamation has begun to reduce spillway operation by using the upper outlets to regulate flow when the reservoir is near full. The spillway drum gates will still be used in instances when inflow exceeds the ability to release water through the upper outlets.

When the reservoir is nearly full, discharge through the spillway by regulating the drum gates is generally preferred. The typical change from spillway control to Ensign valve control, or vice versa, is accomplished in repeated steps of dropping or raising two of drum gates and opening or

closing three Ensign valves until all of the valves are closed or open. In practice, the operation can vary depending on whether Arrowrock Reservoir or Lucky Peak Lake is filled first.

When the reservoir level drops below elevation 3210 feet, usually in the early summer, releases are typically made only through the upper Ensign valves. Sometime in August, the reservoir usually drops below elevation 3118 feet and the lower level Ensign valves are used to control discharge.

After Labor Day, Arrowrock releases are decreased and Arrowrock Reservoir reaches its lowest elevation, an average of 130 feet below full pool. Winter releases average about 300 cfs but are occasionally completely shut off. Whenever the elevation of Lucky Peak Lake is very low, an attempt is made to release 80-100 cfs from Arrowrock Dam to keep the channel downstream of Arrowrock Dam watered. During most winters, inflow to Arrowrock from the South Fork (Anderson Ranch releases) and the Middle Fork exceeds outflow. This results in a slowly rising water level beginning in September and continuing until the reservoir is allowed to refill (see figure 3-1).

To the extent possible, Reclamation attempts to maintain a minimum reservoir elevation of 3078 feet to provide a conservation pool for fish and wildlife. New data (Reclamation, 1997 and 1998) indicate that this elevation would provide a pool of about 19,100 acre-feet with a surface of 676 acres; older data indicate a volume of 28,600 acre-feet at elevation 3078 feet.

The lower Ensign valves of Arrowrock Dam were designed to be used up to full pool elevation, a hydraulic head of 198 feet. Due to concrete damage from cavitation, Ensign valve 1 has been out of service since 1940, and Ensign valves 2 and 3 have been out of service since 1987. Due to cavitation damage, Reclamation has restricted the operation of the remaining 7 lower Ensign valves to 100 feet of head or less except under unusual circumstance when an exception can be granted. This situation has reduced the discharge capacity of the Arrowrock outlet works by about 14,000 cfs compared to the designed discharge capacity. Reclamation allowed an exception to the operation restriction in 1997 and 1999. These exceptions were made with the assumption that the lower Ensign valves would be inspected in the near future for excessive damage due to cavitation.

The lower Ensign valves were designed to discharge to the atmosphere. Construction of Lucky Peak Dam resulted in a reservoir elevation that is normally above the toe of Arrowrock Dam and often is high enough to submerge the lower row of Ensign valves. This further reduces the discharge capacity of the lower Ensign valves.

During years when a large runoff volume is forecasted, large downstream releases are required to provide or maintain flood control space; however, release limitations at Arrowrock can sometimes make it impossible to maintain the required flood control space. The lower valves are used at Arrowrock Reservoir surface elevations up to 3118 feet and the upper Ensign valves are used at higher elevations. As water rises to elevation 3118, the lower Ensign valves are closed and the upper Ensign valves are opened. Maximum flow through the lower valves at a reservoir elevation of 3118 feet is 6,510 cfs, but flow through the upper valves at a reservoir elevation of

3119 feet is 3,600 cfs. As a result, required flood control releases can not be made until the water surface rises, and this does not permit maintaining the required flood control space.

A 1986 study using a 10-year period (1975-1984) of hydrological data with the current valve restrictions, indicated that in 3 of 10 years there were prolonged restrictions of 43 to 81 days. In 7 of 10 years there would be at least one day of flow restriction. During three of the latter years, Lucky Peak would be drawn down to maintain flood releases from the system and in one year the drawdown was significant.

Lucky Peak Dam Operation

Lucky Peak Lake usually fills in June and is maintained near full capacity through Labor Day to maximize recreation opportunities. From Labor Day until the end of the irrigation season in mid-October, Lucky Peak Lake is drawn down rapidly from elevation 3055 feet to meet irrigation demands in the Boise system. In recent years (1990-1999) the elevation reached by mid-October has ranged from 2993 to 2906 feet with an elevation lower than 2962 feet in half of those years. During poor water years, Lucky Peak may fail to fill, and drawdown may begin prior to Labor Day. All releases within the capability of powerplant operation (capacity of 5,500 cfs) are made through the powerplant turbines.

After the irrigation season, releases from the dam are reduced to 150-240 cfs for minimum winter streamflows which are supplied from storage assigned by Reclamation to streamflow maintenance and to IDFG. These flows may be reduced to 80 cfs in dry years. Inflow from Arrowrock Dam and Mores Creek usually exceeds this amount, and the water level in Lucky Peak tends to gradually increase from mid-October to the end of February (see figure 3-1). After February, outflow and the rate of fill depend on flood operations. In normal and dry water years, the refill rate increases after February as does outflow. In good water years, the reservoir may already be at a high level in November through February and outflow may increase continuously from November through early June to maintain storage space for flood control.

Anderson Ranch Dam Operation

Anderson Ranch releases are managed conservatively so that in good water years as much carryover as possible will be held in the reservoir while still meeting minimum streamflows. Releases of at least 300 cfs are made from mid-September to the end of March to maintain fish habitat, and 600 cfs for the remainder of the year if stored water is available. The 300 cfs minimum is usually released through the winter until flood control requirements dictate higher releases in the spring. Reclamation attempts to maintain releases at the powerplant capacity of 1,600 cfs during summer for as long as irrigation demand remains high and stored water is available. This usually extends into mid-August. From mid-August into October, releases are maintained at 600 cfs, then lowered to 300 cfs for the winter until flood control requirements increase flows in late winter and spring.

Anderson Ranch Reservoir fluctuates about 60 feet during a normal water year. The reservoir usually fills in June and remains full until late July when irrigation demand exceeds inflow. Water level continues to drop during the fall and winter as water is released for instream benefits downstream of the dam (see figure 3-1).

Boise River Below Lucky Peak Dam

The 64-mile reach of the Boise River downstream of Lucky Peak Dam is influenced by reservoir operations, irrigation diversions, return flows from irrigation, and local stormwater runoff. Headworks for the two largest diversions on the river, the New York Canal (Boise River Diversion Dam) and the Ridenbaugh Canal (Ridenbaugh Diversion Dam), are just east of the city of Boise. There are numerous other diversions between Boise Diversion Dam and Glenwood Bridge at the west side of Boise. Between the Glenwood Bridge and Parma, near the mouth of the Boise River, there are over 20 irrigation diversions and 10 major drains.

As indicated in previous discussion, releases from Lucky Peak in the early winter may vary from 80 cfs to 240 cfs depending on reservoir system carryover and runoff. Riverflows generally remain near the minimum until flood control operations begin. Flows at Glenwood Bridge are nearly the same as the Lucky Peak release as there is little inflow and runoff in this reach; however, flow of the Boise River at Parma may be twice the Lucky Peak release due to inflow from tributary streams, runoff, and ground water.

Flood control operations from April through June normally limit riverflows to no more than 6,500 cfs at Glenwood Bridge. However, releases from Lucky Peak Dam have been as high as 13,600 cfs with flows as high as 9,560 cfs at Glenwood Bridge; the difference between the Lucky Peak release and the flow at Glenwood Bridge was due to primarily to diversion to the New York Canal at Boise River Diversion Dam. Diversions at Boise River Diversion Dam to fill Lake Lowell are considered in flood control operations.

After flood control operations cease, flows drop rapidly. During the peak of the irrigation season, releases from Lucky Peak are about 4,500 cfs with much of this water diverted to the New York and Ridenbaugh Canals.

In dry years, flows through Boise average about 900 cfs during peak irrigation demand in July and gradually diminish to less than 500 cfs near the end of the irrigation season in October. In average to wet years, the flow is about 1,100 cfs as measured at the Glenwood bridge. Water for salmon flow augmentation has been released during mid-July to mid-August since 1993, bringing the total flow through Boise to 1500 cfs for the 40- to 50-day augmentation period in average water years.

Irrigation diversions between Boise and Middleton, 25 river miles downstream, further reduce riverflow to less than one-half of the flow at Glenwood Bridge. Between Middleton and Parma, irrigation returnflows exceed diversions and increase riverflow. Except for flood control and salmon flow augmentation releases, flows at Parma consist almost entirely of irrigation return flows.

Environmental Consequences

Impact Indicators/Methods for Evaluating Impacts

The No Action and action alternatives involve significant manipulation of Arrowrock Reservoir and Lucky Peak Lake levels for work on the Arrowrock Dam lower level outlets. Manipulation of the reservoir levels specific to implementation of the action alternatives would extend over a 4-year period. Manipulation of reservoir levels specific to the No Action Alternative would involve only 2 years in a 4-year period but would thereafter also require reservoir manipulation every sixth year for the life of the project. Since the reservoirs are operated as a system, changes in operation at one or two reservoirs would require operational changes throughout the system and would affect all reservoir levels and flows in all river reaches from Anderson Ranch Reservoir downstream to the mouth of the Boise River. Variability in annual runoff of the Boise River adds a further complexity in predicting potential hydrological effects. As a result, a reservoir system model (computer model) was used to identify the potential hydrological effects of the alternatives.

It is important to note that hydrologic data is normally collected and displayed in hydrologic years which extend from October 1 to September 30 with the year the same as the calendar year for September 30, e.g., the 1995 hydrologic year begins on October 1, 1994 and ends on September 30, 1995. Reservoir operations and planning are generally based on the hydrologic year. In contrast, construction and maintenance periods may begin at any time during the year and may be limited to only parts of the year. To avoid confusion, the graphic displays for analysis of effects generally include calendar months, indicate construction or maintenance periods related to reservoir drawdown, and denote water years as Water Year 0, 1, 2, and 3. Water Year 0 designates the water year when reservoirs are first drawn down in preparation for the first construction season. Water years 1, 2, and 3 are generally congruent with the first, second, and third construction seasons, however construction would usually begin about 1 month earlier than the water year. Table 3-5 identifies calendar months, water years, and construction seasons over a 4-year period and summarizes reservoir elevations and streamflow targets for construction.

Reclamation modeled 4-year sequences within the 1961 to 1998 period of record. Within this period there are thirty-five 4-year sequences, e.g., 1961-1964, 1962-1965, 1963-1966, etc. Runoff for each 4-year sequence was totaled and arrayed from the largest to lowest runoff. Recognizing that there is little chance that the wettest or driest 4-year sequence would occur during actual construction, representative wet, average, and dry sequences were selected for display and to simplify analysis. The wet sequence is the 85th percentile runoff sequence and the dry sequence is the 15th percentile runoff sequence. Also, recognizing that the deepest drawdown would occur in the fourth year, each scenario included a fourth year that represents that scenario, e.g., the fourth year for the wet scenario is a wet year. The 4-year sequences selected for display are: wet sequence–1980-83, average sequence–1961-64, and dry sequence–1988-91.

Results of the hydrologic models were depicted as **exceedence curves** and **hydrographs** designed to show major differences, similarities, and trends among the alternatives. Exceedence curves show the probability of a specific flow or reservoir elevation being exceeded in a given

Arrowrock Valve Rehabilitation / Replacement Hydrology Summary (Average Water Supply Conditions)

Construction / Maintenance Season 1

	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
No Action						**LP Res.:** Start draft 3rd week (el. 3035 by end of month) **A.Ranch:** 10-30 ft. >norm. **S.Fork:** Min. flows by 2nd week (600 CFS)	**A.Ranch:** 10-30 ft. >norm. **S.Fork:** Min. flows by 9/15 (300 CFS)	**LP Res.:** el.2962 by 1st week **L.Boise:** After 10/15 pass inflows **A.Ranch:** 10-30 ft. >norm. **S.Fork:** Min. flows (300 CFS)	**Arrow Res:** <el. 3007 11/1 - 12/30 **Lucky Peak Res:** btwn el. 2962 and 2957 11/1 - 12/30 **Anderson Ranch Res:** 10-30 feet higher than normal. **L.Boise**: flows at 700-1000 CFS **S.Fork:** Min. flows (300 CFS)	**Arrow Res.:** Filling **LPRes**: filling **L.Boise** back to minimum flows (150 cfs)	
Alternative A						**Arrow Res.:** >el. 3110 **LP Res.:** Start Draft 2nd week; el. 3035 by end of 3rd week; el. 3020 by end of month **S.Fork:** Min. flows by 8/15 (600 CFS)	**Arrow Res.:** >el. 3110 **LP Res.:** el. 3000 by 9/15 **S.Fork**: Min. flows 9/15 (300 CFS)	**Arrow Res.:** >el. 3110 **LPRes:** < el. 3000 **S.Fork:** Min. flows (300 CFS)				
Alternative B						**Arrow Res.:** >el. 3110 **LP Res.:** Start Draft 2nd week; el. 3035 by end of 3rd week; el. 3020 by end of month **S.Fork:** Min. flows by 8/15 (600 CFS)	**Arrow Res.:** >el. 3110 **LP Res.:** el. 3000 by 9/15 **S.Fork**: Min. flows by 9/15 (300 CFS)	**Arrow Res.:** >el. 3110 **LPRes:** < el. 3000 **S.Fork:** Min. flows (300 CFS)				

Construction / Maintenance Season 2

	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
No Action												
Alternative A						**Arrow Res.:** >el. 3110 **LP Res.:** Start Draft 2nd week; el. 3035 by end of 3rd week; el. 3020 by end of month. **S.Fork:** Min. flows by 8/15 (600 CFS)	**Arrow Res.:** >el. 3110 by 9/15 **LP Res.:** el. 3000 by 9/15 **S.Fork**: Min. flows by 9/15 (300 CFS)	**Arrow Res.:** >el. 3110 **LPRes:** < el. 3000 **S.Fork:** Min. flows (300CFS)				
Alternative B						**Arrow Res.:** >el. 3110 **LP Res.:** Start Draft 2nd week; el. 3035 by end of 3rd week; el. 3020 by end of month **S.Fork:** Min. flows by 8/15 (600 CFS)	**Arrow Res.:** >el. 3110 **LP Res.:** el. 3000 9/15 **S. Fork:** Min. flows by 9/15 (300 CFS)	**Arrow Res.:** >el. 3110 **LPRes:** < el. 3000 by 10/15 **S. Fork:** Min. flows (300 CFS)	**Arrow Res.:** >el. 3110 **LPRes:** < el. 3000 **S. Fork:** Min. flows (300 CFS)			

Construction / Maintenance Season 3

	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
No Action						**LP Res.:** Start Draft 2nd week; el. 3035 by end of month. **A.Ranch:** 10-30 ft. >norm. **S.Fork:** Min. flows by 2nd week (600 CFS)	**LP Res.:** continues to draft thru Sept. **A.Ranch:** 10-30 ft. >norm. **S.Fork:** Min. flows by 9/15 (300 CFS)	**Arrow Res.:** < el. 2975 by 10/1 **LP Res.:** between el. 2962 and 2957 **L.Boise:** flows at 700-1000 CFS 10/1-3/1 **A.Ranch:** 10-30 ft. >norm **S.Fork:** Min. flows (300 CFS)			
Alternative A						**LP Res.:** Start Draft 1st week; el. 3035 by last week; el. 3026 by end of month **A.Ranch:** 10-30 ft. >norm. **S.Fork:** Min. flows by 3rd week (600 CFS)	**Arrow Res.:** < el. 3027 by 9/15 **LP Res.:** el. 3000 by 9/15 **A.Ranch:** 10-30 ft. >norm. **S.Fork:** Min. flows by 9/15 (300 CFS)	**Arrow Res.:** < el. 3027 **LP Res.:** < el. 2962 by 10/15 **L.Boise:** flows at 700-1000 CFS by 10/15 **A.Ranch:** 10-30 ft. >norm. **S.Fork:** Min. flows by 9/15 (300 CFS)	**Arrow Res.:** < el. 3027 **LP Res.:** between el. 2962 and 2957 **L.Boise:** flows at 700-1000 CFS **A.Ranch:** 10-30 ft. >norm. **S.Fork:** Min. flows (300 CFS)		
Alternative B					**LP Res.** Start Draft mid month	**LP Res.:** el. 3035 by last week; el. 2979 by end of month **L.Boise:** Start high flows 8/1 (>2,000 CFS at Glenwood) **A.Ranch:** 10-30 ft. >norm **S.Fork:** Min. flows by 8/1 (600 CFS)	**Arrow Res.:** >el. 3007 by 9/1 **LP Res.:** el. 2962 by 2nd week **A.Ranch:** 10-30 ft. >norm. **S.Fork:** High flows start 2nd week to meet irrigation demand	**Arrow Res.:** >el. 3007 **LP Res.:** Between el. 2962 and 2957 **L.Boise:** 10/15-31 flows at 700-1000 CFS **A.Ranch:** 10-30 ft. >norm **S.Fork:** High flows continue thru 10/15 to meet irrigation demand	**Arrow Res.:** >el. 3007 end 11/7 **LP Res.:** Between el. 2962 and 2957 until 11/7 **L.Boise:** flows reduced to min. at 11/7 **A.Ranch:** 10-30 ft. >norm **S.Fork:** Min. flows by 11/1 (300 CFS)			

All elevations are in feet. ARK = Arrowrock Reservoir LP = Lucky Peak Lake

Water Year: 0 1 2 3

Yellow indicates target elevation period

No action alternative repeats the 3rd construction season every six years after that season

Table 3-5

period. Hydrographs indicate probable reservoir elevations and river flows over a 4-year period. These visual aids were provided to resource specialists for use in their specialty and are maintained in files at the Reclamation's Pacific Northwest Regional Office. Regardless of possible shortcomings, the **hydrology** model and the resultant hydrographs represent a best attempt at identifying potential river and reservoir changes given the wide range of possible runoff conditions and the limitations of current state of the art computer simulations of basin hydrology.

Some of the assumptions necessary for computer modeling differ significantly from actual operations. For example, the model uses "perfect forecasting," i.e. flows and reservoir levels are regulated in the model knowing the exact amount of annual runoff for the year. In actual operations, operators adjust reservoir levels and riverflows based on the amount of runoff to that date and estimates (that may prove wrong) of further runoff for the season. In addition to other assumptions, the model also assumes that reservoirs will be at average levels at the beginning of the 4-year sequence. Model assumptions and differences from actual operations are discussed in appendix D.

In the following sections, the general trends shown by the exceedence curves and hydrographs are discussed for each alternative with a focus on comparison of alternatives.

No Action Alternative

The No Action Alternative would involve numerous reservoir drawdowns for outlet works maintenance over the life of the project. However, the analysis concentrates primarily on the effects of drawdown in Maintenance Season 1 and Maintenance Season 3 and recognizes that future drawdowns every other sixth year would be similar to Maintenance Season 3; Water Year 9 drawdown and every other sixth year drawdown would be similar but not as deep a drawdown as Maintenance Season 3. The discussion of the No Action Alternative refers to a period of 4 water years which is the period of effect for the action alternatives. The No Action Alternative in this period includes initial inspection of the Ensign valves and sluice gates in Maintenance Season 1 and the first major rehabilitation effort in Maintenance Season 3.

Arrowrock Reservoir

Under No Action, Arrowrock Reservoir would be drafted through the summer and continue to be drafted through September until the necessary low pool is reached then held down through the maintenance years (see tables 2-3 and 3-5 for construction requirements). After March 1, Arrowrock would refill fairly rapidly with a minimum pool goal of 100,000 acre-feet by May 1.

In the first maintenance season, Arrowrock Reservoir would be drawn down and held at elevation 3007 feet from November 1 through December 30. The pool at this elevation would be about 160 acre-feet, covering about 16 acres. In Maintenance Season 3, and every 12th year thereafter, the drawdown would be to elevation 2975 feet from October 1 to March 1. At 2975 feet, Arrowrock Reservoir would be "run-of-river" with virtually no pool. Drawdowns in Water Year 9 and every 12th year thereafter would be to the same level as Maintenance Season 1 (3007 feet) but would extend from October 1 to March 1.

In years when Arrowrock is drawn down to 2975 for sluice gate inspection and overhaul, all reservoir inflow must be passed through the sluice gates not being overhauled; the operable gates would likely have a total capacity of about 1,100 cfs. There would be a 76 percent probability that inflow would exceed outlet capacity during October 1 to March 1. During average and high water years, flooding of the sluice gate construction area could be expected as inflow to Arrowrock often exceeds 1,100 cfs during the drawdown period.

Arrowrock operations would be similar during wet, average, or dry water years except that the reservoir might not refill if the drawdown to elevation 2975 feet (sluice gate maintenance) occurs in a dry year. However, the reservoir would also not fill in a similar dry year when there was no maintenance on the lower outlet works.

During years when there is no maintenance work on the lower outlet works, Arrowrock would be drafted in the summer and would begin to gradually refill after the Labor Day weekend, similar to current operations.

Lucky Peak Lake

Under No Action, Lucky Peak Lake would be drafted to elevation 2962 during all years of inspection or overhaul of Arrowrock Dam Ensign valves and sluice gates (see table 3-5 for reservoir elevations). To reach an elevation of 2962 feet by October 1, Lucky Peak Lake would begin drafting in late summer. The date to begin drawdown would depend on runoff, irrigation demand, and other factors. Elevation 2962 feet is lower than the normal fall/winter pool in most average to good water years. In dry years or whenever flood control space is needed, it is not uncommon to draft Lucky Peak below 2962 feet during the winter.

In average years, Lucky Peak Lake may be able to remain full for a longer period with drawdown not needed until mid-August. An example scenario would be to begin drawdown in the second week of August and reach an elevation of 3035 feet at the end of August. Meeting irrigation demand would likely bring the elevation to 2962 feet by October 1. In wet years, drawdown could begin as soon as flood control operations are completed, which could be in mid-July. However drawdown would be more gradual with critical elevations being met throughout most of August. In a dry year, irrigation demand would result in a drawdown sufficient to meet critical elevations for construction without any special operation.

An attempt would be made to maintain Lucky Peak Lake between elevation 2062 and 2957 feet, a pool of 88,000 acre-feet, through the drawdown period and thereafter for maintenance of fish habitat. This elevation has been requested to reduce the possibility of entrainment of bull trout from Lucky Peak into the lower Boise River. In Maintenance Season 3, that elevation might not be maintained and still meet irrigation deliveries from October 1 to October 15 in an average water year because of the limited capacity of the sluice gates to pass flows. Lucky Peak Lake could be drafted lower than 2957. After irrigation deliveries cease, Lucky Peak Lake would be allowed to rise to the target minimum pool elevation which should be attained between October 15 and October 31 in an average water year. During a wet year, Lucky Peak Lake would not be drafted as low and would refill quicker to target minimum pool elevation. During a dry year, it is anticipated that irrigation demand would decrease more than inflow would decrease, so the

actual draft of Lucky Peak Lake could be less than in an average water year. However, refilling or maintaining an elevation of 2957 after October 15 may not be possible in a dry period. A lower elevation late in the maintenance season could also be required for flood control operations.

Summer operation of Lucky Peak, in years when there is no maintenance on the lower level outlets of Arrowrock Dam, would be similar to existing operations. In normal to wet years, Lucky Peak Lake would be held at elevation 3055 feet through Labor Day. In dry years, however, summer operation of Lucky Peak Lake could approach that required in years of maintenance on the Arrowrock Dam lower outlets.

Lower Boise River

Under No Action, flows through the city of Boise, as measured at the Glenwood Bridge, may be influenced in late summer and during fall and winter in those years when the Arrowrock Dam lower outlets are inspected and overhauled. Release of flows in excess of irrigation demand and salmon flow augmentation may be required during late July, August, and September in wet and above average years. Flows at Glenwood Bridge could increase from historical normals of 1,000 to1,500 cfs in average years to more than 2,000 cfs in wet years.

During October through the end of February, flows at Glenwood Bridge would likely be 700-1,000 cfs with short term higher spikes. These flows contrast with historically lower flows. The higher flows and short-term spikes would result from maintaining low water elevations at Arrowrock Reservoir and Lucky Peak Lake while passing the normal 300 cfs release from Anderson Ranch, other inflow from the Middle Fork/North Fork Boise River, and inflow from Mores Creek to Lucky Peak Lake.

The New York Canal may divert as much as 1,000 cfs of excess high winter flows, which would lessen the flow through the city of Boise (Glenwood Bridge). However, the modeling assumes that New York Canal diversion would not begin before January 1, as the canal is often closed for maintenance at the end of the irrigation season to December 31. In actual operations, the BPBOC may choose to divert water prior to January 1 and that would lessen flow in the lower Boise River.

Anderson Ranch Reservoir and South Fork Boise River

Under No Action, Anderson Ranch Reservoir levels would be affected during the fall and winter only in years in which there is maintenance of the lower outlets of Arrowrock Dam and only in years of normal or high runoff. In years of normal runoff, Anderson Ranch Reservoir could be about 10 to 30 feet higher compared to years of no maintenance. In dry years, maintenance of the Arrowrock outlets would have little effect on Anderson Ranch Reservoir.

In maintenance years with average to high runoff, flows of the South Fork Boise River downstream of Anderson Ranch Dam would be affected. Flood control releases from Anderson Ranch that are sometimes needed in February would be postponed until maintenance activities are completed. As a result, flood control releases would be larger but for shorter periods.

However, these higher flows would be within the historical operating ranges, and flows above 1,600 cfs would likely end by mid-July.

Alternative A (Preferred Alternative)

Reservoir operations for Alternative A have the goals of maintaining a residual pool in Arrowrock Reservoir and limiting the use of sluice gates to reduce the release of sediment into Lucky Peak and down stream during Construction Season 3.

Arrowrock Reservoir

Under Alternative A, releases would be made through the upper row of Ensign valves through the first two construction seasons. That is, Arrowrock Reservoir elevation would be maintained at or above 3110 feet (above the upper valves) and this would provide a pool of about 49,000 acre-feet. This elevation would be higher than normal for average to dry years but within the normal operating range. The average elevation of Arrowrock for September 1 is 3088 feet.

In Construction Season 3, Arrowrock Reservoir would begin normal draft from mid-July in a wet year to mid-June in a dry year and would continue to be drafted until it reached elevation 3027 feet. The reservoir would be held at elevation 3027 feet from September 15 to March 1, with brief dips below elevation 3027 feet to allow installation and removal of stoplogs. At this elevation the pool would contain approximately 1,500 acre-feet and cover about 135 acres. The residual pool would extend about 3 river miles upstream and would range in depth from 37 feet at the dam to 18-25 feet at the midway point (1.3 river miles upstream from the dam). This pool would be about 51 feet below the target minimum pool elevation of 3078 feet that Reclamation attempts to maintain under normal operations.

Winter rain storms may cause inflow to exceed the hydraulic capacity of the operable conduits in the lower row of Ensign valves. In this case, the construction site would be allowed to flood for a total of 5 workdays before the sluice gates would be operated to prevent flooding the upstream work area. The probability that work site would be flooded more than 5 cumulative days and the sluice gates would be operated is 15 percent. The probability that a storm event would flood the construction site, even with 5 sluice gates open, is about 5 percent. This estimate is based on three rain-on-snow events that occurred between 1936 and 2000 and produced inflows significantly higher than the outlet capacity of seven lower Ensign valves and all five sluice gates at a reservoir elevation of 3027 feet.

In an average or wet year, the third construction season drawdown for Alternative A, compared to drawdown for No Action in Maintenance Season 3, would be slightly longer in duration but would leave a 1,500 acre-foot reservoir pool; No Action would leave little or no pool. If Construction Season 3 is in a dry sequence of years, it is possible that Arrowrock Reservoir may not fill; the same situation as would exist for No Action.

After Construction Season 3, Arrowrock Reservoir would not be drawn down for maintenance work on the outlet works. This is in sharp contrast to No Action which would require deep drawdowns for continued rehabilitation and inspection every sixth year.

Lucky Peak Lake

Through the first two construction seasons, Lucky Peak Lake would begin drafting from early to mid-August, depending on runoff. The reservoir target elevation is 3000 feet (134,000 acre-feet content) or lower from September 15 to March 1. Some drawdown of Lucky Peak would continue after construction begins on September 15 and drawdown would continue to the end of the irrigation season (October 15).

For the third construction season, Lucky Peak Lake draft would begin in early August in a wet year to mid-August in an average year and the reservoir elevation would be below the elevation of the Arrowrock Dam lower row of Ensign valves (elevation 3000) by September 15. The elevation of Lucky Peak Lake at the end of the irrigation season would be near normal for that time of year. A hydraulic head of only 9 feet on 7 Ensign valves would limit discharge capacity into Lucky Peak Lake. During this period, the Anderson Ranch Dam minimum release of 300 cfs and inflow to Arrowrock Reservoir at Twin Springs (long-term average of 390 cfs) would be passed to Lucky Peak Lake to the extent possible. These flows would not meet irrigation needs. As a result, Lucky Peak Lake would be drafted to about 2946 feet between September 15 and October 15 to meet irrigation demands.

As indicated for No Action, Reclamation would try to hold a target minimum pool of 88,000 acre-feet (elevation 2957 feet) for Lucky Peak Lake to reduce the possibility of entrainment of bull trout from Lucky Peak to the lower Boise River.

An elevation of 2957 could not be maintained in Construction Season 3 and meet irrigation deliveries in an average water year. Additional calculations indicate that irrigation deliveries could be met without using Arrowrock Dam sluice gates if Lucky Peak Lake would be drafted to about elevation 2946 by October 15; this is 7 feet and 15,500 acre-feet below the target minimum pool. After irrigation deliveries cease, Lucky Peak Lake would be allowed to rise to the target minimum pool elevation which should be attained by October 31 in an average water year. During a wet year, Lucky Peak Lake would not be drafted as low and would refill quicker to target minimum pool elevation. During a dry year, it is anticipated that irrigation demand would decrease more than inflow would decrease, so the actual draft of Lucky Peak Lake could be less than in an average water year. However, refilling or maintaining an elevation of 2957 feet after October 15 may not be possible in a dry period.

The drawdowns of Lucky Peak Lake for Alternative A could start earlier and be at a much faster rate than under No Action; however, two of the Alternative A drawdowns would not be as deep as the No Action drawdowns. In addition, Alternative A would require only 3 drawdowns over the project life compared with 9 drawdowns for No Action.

Lower Boise River

Flows of the lower Boise River would be changed little by construction activities through the first two construction seasons but would be significantly affected in Construction Season 3. During the first two construction seasons there would most likely be no need for releases beyond normal demands and winter flood flows would be stored to the extent flood control operations allow.

Flows in Construction Season 3 would also be higher through the winter due to restrictions on maximum elevations for Arrowrock Reservoir and Lucky Peak Lake. All flows of the North and Middle Fork of the Boise River, releases from Anderson Ranch, and flows of Mores Creek would be passed through the system to the lower Boise River similar to what would occur with No Action.

The New York Canal may divert as much as 1,000 cfs of excess high winter flows, which would lessen the flow through the city of Boise (Glenwood Bridge). However, the modeling assumes that New York Canal diversion would not begin before January 1, as the canal is often closed for maintenance from the end of the irrigation season to at least December 31. In actual operations, the BPBOC may choose to divert water prior to January 1 and that would lessen flow in the lower Boise River.

Flows of the lower Boise River would be generally similar in Construction Seasons 1 and 2 under Alternative A and would be less than under No Action. Under Alternative A, water would be stored in Arrowrock Reservoir in those years whereas Arrowrock Dam would be passing all inflow in Maintenance Season 1 under No Action. Flows in Construction/Maintenance Season 3 would be similar for Alternative A and No Action.

Anderson Ranch and South Fork Boise River

To ensure system refill, Anderson Ranch Reservoir carryover could be maximized by reducing Anderson Ranch Dam releases to normal minimum flows of 600 cfs earlier than under normal operations. As a result, Anderson Ranch Reservoir elevation during the winter of the construction years under Alternative A would be slightly higher than historical elevations and would be similar to that for No Action.

Flows in the South Fork under Alternative A would be similar to those that would occur under No Action during maintenance years. Flood control releases would be delayed as much as possible until after March 1 because of the need to maintain low flows through Arrowrock Dam. In addition, since the Construction Season 3 drawdown under Alternative A begins 2 weeks earlier than under No Action, some late season irrigation water may be required from Anderson Ranch which would extend higher flows in the South Fork beyond that of No Action. During a dry sequence, stored water may not be available for late irrigation season releases, so flows in the South Fork Boise River would be similar to those under No Action.

Alternative B

Operations for Alternative B are essentially the same as for Alternative A, except that the drawdown for the third year of construction is deeper but for a shorter period of time.

Arrowrock Reservoir

Arrowrock Reservoir elevations would be identical to Alternative A through the first two seasons of construction.

Construction Season 3 drawdown would be to elevation 3007 feet from September 1 to November 7. This elevation would leave a pool of about 160 acre-feet with a surface of 16 acres. During this period, the sluice gates would be operated to maintain Arrowrock Reservoir elevation.

In Construction Season 3, the Alternative B drawdown would begin about 2 weeks earlier and the elevation of Arrowrock Reservoir would be about 20 feet lower with 1,400 acre-feet less volume than under Alternative A. However the elevation would be about 32 feet higher than under some No Action maintenance years. The Alternative B drawdown would be only 9 weeks compared to a 5½-month drawdown under Alternative A and a 5-month drawdown under No Action.

Alternative B is similar to Alternative A and No Action in that Arrowrock Reservoir may not fill after construction is completed if Construction Season 3 is a dry year. However the Arrowrock Reservoir would fill to a higher level under B, because filling would begin 3 months earlier than under Alternative A or No Action.

Lucky Peak Lake

Lucky Peak Lake elevations would be identical to Alternative A through the first two construction seasons but would be different in third construction season.

In Construction Season 3 under Alternative B, Lucky Peak Lake draft would begin at the end of July, reach elevation 3035 in a week, and reach elevation 2962 feet by September 15. The drawdown would be maintained until November 7. Since the sluice gates would be capable of passing more late season irrigations flows there would be less need to rely on Lucky Peak Lake storage than under Alternative A. This would allow maintenance of the 2957 foot minimum pool goal throughout construction season. Alternative B drawdown is to the same level as Alternative A, but the drawdown would start about 1 month earlier and lasts about 3 months less.

Because more water would need to be spilled from the system during a wet year, drawdown would tend to begin earlier. During a dry year the timing of drawdown would probably be similar to Alternative A.

In a dry year, Lucky Peak Lake may not fill after construction, i.e., Alternative B would be similar to Alternative A and No Action. However, under Alternative B, the reservoir would fill to a higher level because fill would begin 3 months earlier than under Alternative A and No Action.

Lower Boise River

Lower Boise River flows would be identical to Alternative A through the first two construction seasons but would be different in Construction Season 3.

Riverflows in Construction Season 3 would be higher than historical beginning at the end of July to draft the reservoirs. Riverflows would be higher during this period under average or wet scenarios. However, construction would be over by November 7, so Lucky Peak would not need to pass inflows throughout the winter as under Alternatives A and the No Action. Lower Boise River flows after November 7 would resemble a year with no construction.

Anderson Ranch Reservoir and South Fork Boise River

Anderson Ranch Reservoir elevations and South Fork Boise River flows under Alternative B would be identical to Alternative A through the first two construction seasons but would differ in the third construction season.

In Construction Season 3, Anderson Ranch Reservoir elevations for Alternative B during an average or wet scenario would be similar to those for Alternative A; the reservoir would be drawn down earlier under Alternative A. This is because Anderson Ranch Reservoir under Alternative B would supply more of the late season irrigation water in September and October while Alternative A or No Action would provide water earlier (mid August). As a result, South Fork flows could be as high as 2,500 cfs in September under Alternative B; flows are normally reduced to 300 cfs at this time. Since construction would be finished prior to winter flood control releases, there would be no effect on the South Fork in the spring following construction.

Water Quality

Affected Environment

Boise River water quality is managed by the State of Idaho under a framework provided by the CWA. Idaho establishes water quality standards for specific physical and chemical parameters in order to provide suitable conditions to support beneficial uses, including irrigation, public water supply, recreation, and aquatic life (IDAPA 58.01.02). Section 303(d) of the CWA requires that states develop and implement water quality management plans or **Total Maximum Daily Loads** (TMDL's), including pollutant load allocations for stream segments where water quality is inadequate to fully support designated beneficial uses.

Designated beneficial uses for the South, Middle, and North Forks of the Boise River, including Arrowrock and Anderson Ranch Reservoirs and Lucky Peak Lake, are domestic water supply, agricultural water supply, cold water biota, salmonid spawning, primary and secondary contact recreation, special resource water, aesthetics, wildlife habitat, and industrial water supply.[1] Lake Lowell designated uses includes agriculture water supply, industrial water supply, wildlife habitat, aesthetics, warm water aquatic life, primary contact recreation, and special resource water.

Table 3-6, compiled from the 1998 Idaho 303(d) list, summarizes pollutants in reaches and tributaries that affect or are affected by Arrowrock Dam operations.

[1]The State of Idaho defines and designates uses. See Idaho Administrative Code, Department of Environmental Quality (IDAPA 58.01.02)

Table 3-6. Water Quality Impacted Waterbodies Upstream and Downstream of Arrowrock Reservoir		
Stream	**Reach**	**Pollutant**
Hydrologic Unit Code 17050111		
Middle Fork Boise River	Wilderness Boundary to Arrowrock Reservoir	Sediment
Upper Browns, Buck, James, Lost, Lost Man, Phifer, and Swanholm Creeks, and Roaring River	Headwaters to confluence with Middle Fork Boise River	Sediment
Hydrologic Unit Code 17050113		
South Fork Boise River	Anderson Ranch Reservoir to Arrowrock Reservoir	Sediment
Willow Creek	Headwaters to Arrowrock Reservoir	Sediment
Cayuse and Rattlesnake Creeks	Headwaters to South Fork Boise River	Sediment
Smith Creek	Tiger Creek to South Fork Boise River	Sediment
Hydrologic Unit Code 17050114		
Boise River	Lucky Peak Dam to Barber Dam	Flow alteration
Boise River	Barber Dam to Star	Sediment
Boise River	Star to Notus	Nutrients, sediment, temperature, and bacteria
Boise River	Notus to Snake River	Pathogens, temperature, nutrients, and sediment
Lake Lowell	Reservoir	Dissolved oxygen, nutrients
Source: 1998 Idaho 303(d) list		

River Reaches Upstream of Arrowrock Reservoir

Beneficial uses of the South Fork, and Middle Fork are impacted by sediment. Lack of vegetative cover, fires, roads, logging, and grazing contribute sediment to Arrowrock Reservoir and inflowing streams.

Past mining activities in the watershed on the Middle Fork of the Boise River also contribute sediment to downstream waters. Some of the mine tailings or sediments settled out behind Kirby Dam on the Middle Fork of the Boise River near Atlanta, Idaho. In 1991, Kirby Dam failed, and an estimated 69.8 acre-feet (112,600 cubic yards) of sediment were deposited downstream. After the failure, Reclamation collected sediment samples from seven locations within Arrowrock Reservoir and analyzed them for a broad spectrum of metals. Results of these analyses (see table C-1 in appendix C) indicate that metal concentrations in the sediments in Arrowrock Reservoir are within observed concentration ranges for the Western United States (IDWR 1991). Kirby Dam was replaced to stabilize the sediments that remained in the old pool area.

Anderson Ranch Reservoir water quality supports designated beneficial uses. Flows of the South Fork Boise River are controlled by Anderson Ranch Dam. Reclamation releases at least 300 cfs during September through March and 600 cfs during April through August to maintain a healthy coldwater fishery. Sediment is listed as a pollutant for the South Fork downstream from Anderson Ranch Dam; however, most of the sediment in this river reach probably originates from tributaries downstream of Anderson Ranch.

Arrowrock Reservoir

A 1997 sedimentation survey of Arrowrock Reservoir (Reclamation, 1998) found that the reservoir has lost over 14,400 acre-feet of capacity since 1947; an average loss rate of about 280 acre-feet per year. The survey also indicated that sediment deposited at the base of the dam is approximately 20 feet above the sluice outlets.

Sediment carried into Arrowrock Reservoir by tributary streams generally deposits uniformly in the lower portion of the reservoir and upstream along the North Fork arm. One exception occurs just upstream of the Dam where more than 20 feet of sediment has accumulated and another upstream about 7 river miles along the North Form arm where a delta deposit can be seen (USBR, 2000). Most sediment deposited in the reservoir above 4 river miles upstream, approximate elevation 3203 feet, usually redistributes each year when the reservoir is drawn down to meet irrigators demands.

Despite the sediment load of upstream tributaries, water quality of Arrowrock Reservoir currently provides suitable conditions to support existing beneficial uses including domestic water supply, agricultural water supply, cold water biota, salmonid spawning, primary and secondary contact recreation, and special resource water. As part of an on-going reservoir monitoring program for operating projects, Reclamation collects water quality data every 3 years from Arrowrock Reservoir at a site 500 feet upstream of the dam. These samples are analyzed for chemical, physical, trace metal, and biological parameters. In response to the terms and conditions of the 1998 Upper Snake Operations BO, Reclamation began a reservoir productivity study of Arrowrock Reservoir in 1999. This study requires the collection of additional water quality information twice monthly for the purpose of defining the impacts of various minimum pool alternatives on ESA-listed bull trout populations. The study is scheduled to be completed by 2004. Surface water quality data collected during January and February and October through December 1999 are summarized in table C-2 (see appendix C).

Lucky Peak Lake

Water quality of Lucky Peak Lake provides suitable conditions to support designated beneficial uses. Most of the sediment that passes through Arrowrock Dam is released during sluice gate operation for periodic inspection and maintenance of the Ensign valves and during drought years when exposed bottom sediments are redistributed by the river. Much of this sediment settles in Lucky Peak Lake.

During flood control operations, periods of high discharge from the Ensign valves occasionally cause the water near the base of the dam to exceed the Idaho State standard of 110 percent saturation for **total dissolved gases** (TDG).

Boise River Downstream of Lucky Peak Dam

Water passing Lucky Peak Dam is of excellent quality but degrades downstream due to municipal storm runoff, treated effluent, and irrigation returns (see table 3-6). The Idaho Department of Environmental Quality (IDEQ) No-Net Increase Policy (TMDL) implements provisions in IDAPA 58.01.02.054.04 and IDAPA 58.01.02.054.05 along with the provisions outlined in the No-Net Increase Policy. These provisions, policy, and IDAPA are to be utilized on waters determined not fully supporting designated or existing beneficial uses until the TMDL allocation has been completed or the water body delisted (IDEQ Policy No. PM98-2). Some provision of the No-Net Increase Policy may be applicable to the lower Boise River.

The beneficial uses for the Boise River downstream of Lucky Peak Dam are summarized in table 3-7.

Table 3-7. Designated Beneficial Uses for the Boise River Downstream of Lucky Peak Dam

River Reach	Designated Uses
Lucky Peak Dam to River Mile 50 (Veteran's Parkway)	Domestic water supply Agricultural water supply Industrial water supply Cold water biota Salmonid spawning (Boise River Diversion Dam to RM 50) Wildlife habitat Primary contact recreation Aesthetics Special resource water[1]
River Mile 50 (Veteran's Parkway) to Indian Creek	Agricultural water supply Industrial water supply Cold water biota Salmonid spawning Wildlife habitat Primary Contact Recreation Aesthetics
Indian Creek to mouth	Agricultural water supply Industrial water supply Cold water biota Primary Contact Recreation Wildlife habitat Aesthetics

[1]Designated on Boise River between Lucky Peak Dam and Boise River Diversion Dam only
Source: Idaho Administrative Code, Department of Environmental Quality (IDAPA 58.01.02)

The Lower Boise TMDL defines targets for total suspended sediment (TSS) for the Boise River downstream of Lucky Peak Dam that are to be met within 10 years. The targets for TSS, 50 milligrams per liter (mg/L) for no more than 60 days and 80 mg/L for no more than 14 days, were developed by the IDEQ (IDEQ, 1998). The TSS TMDL was designed to provide protection for the mix of cold and warm water species that inhabit the Lower Boise River.

Lake Lowell

Water is supplied to Lake Lowell through the New York Canal. Water diverted at Boise River Diversion Dam to the New York Canal is of the same quality as the Lucky Peak Dam outflow. Although water quality in the upper Boise River is of relatively high quality, agricultural return flows contribute significant quantities of nutrients to the New York Canal between the head of the canal and Lake Lowell. Lake Lowell beneficial uses include agricultural and industrial water supply, warm water biota, wildlife habitat, primary contact recreation, aesthetics, and special resource water. Use of Lake Lowell for primary contact recreation and warm water biota is impaired by the high nutrient loading, algal blooms, and dissolved oxygen depletion. Lake Lowell is on the Idaho 303 (d) list for nutrients and dissolved oxygen. A TMDL is scheduled to be completed in 2006.

Environmental Consequences

Impact Indicator/Methods for Evaluating Impacts

Water quality impact analysis is based on available water quality data, the Idaho State standards, and hydrology exceedence probabilities developed from modeling studies. Sediment would be flushed from Arrowrock Reservoir when using Arrowrock Dam sluice gates. The quantities were determined through use of sediment quantification and transport information provided by Reclamation's Denver Technical Service Center, Water Resources Sedimentation and River Hydraulic Group (Reclamation, 1999a). Data on sediment flushing and downstream total suspended solids levels during sluice gate operation at Black Canyon Dam and during lower level gate operation at American Falls Dam was the basis for projecting impacts. Discussion of Black Canyon and American Falls drawdowns and presentation of data is provided in appendix C.

There are several water quality concerns. These are movement of sediment, suspended sediment concentrations, turbidity, TDG levels, dissolved oxygen concentration, lower Boise River TMDL, and water temperature.

The Idaho State standard for TDG is 110 percent saturation, the TSS TMDL targets for the lower Boise River are 50 mg/L for no more than 60 days and 80 mg/L for no more than 14 days (IDEQ, 1998). The Idaho State standard for turbidity is no increase over the background turbidity by 50 NTU instantaneously or more than 25 NTU for more than 10 days below any applicable mixing zone. The Idaho State standard on dissolved oxygen is 6 mg/L, although there are some exceptions to the dissolved oxygen standard applicable to reservoirs.

No Action Alternative

Drawdowns of Arrowrock Reservoir and Lucky Peak Lake would occur in Maintenance Season 1, 3, and every sixth year thereafter for a total of 9 drawdowns in a 50 year period. Arrowrock Dam sluice gates would be used during each drawdown, and large amounts of sediment would be released downstream. The water quality effects described for No Action would be expected to occur every 6 years.

Arrowrock Reservoir

During the last phases of drawdown, **turbidity** in the Arrowrock pool would temporarily increase due to sluice gate operations, sloughing of unstable banks, and redistribution of bottom sediment. The water would be a mocha color (see figures 2-4 and 2-5). After an undetermined period, the flow would tend to clear, with most turbidity limited to the river reach just upstream of the dam. On occasion, wave action and storm events would also cause temporary increases of turbidity that would likely last for several days after the storm event. Specific turbidity and the concentration of total suspended solids upstream from Arrowrock Dam cannot be determined from available data. Turbidity and concentration of total suspended solids of the river and run-of-river conditions or in the residual pool (160 acre-feet at 3007) and in Arrowrock releases would vary throughout the drawdown periods and would be dependent primarily on inflow velocity and variations in pool elevation. Sediment carried with the inflow to Arrowrock Reservoir during storm events would most likely pass through Arrowrock Reservoir into Lucky Peak Lake.

A 1997 sedimentation survey of Arrowrock Reservoir indicates that sediment accumulation at the dam is 20 feet higher than the elevation of the sluice gates (Reclamation, 1998). The initial operation of the sluice gates would release the greatest amount of sediment downstream. However, the total volume of sediment released through the sluice gates would depend on the number of gates used, duration of operation, and magnitude of flow through the gates. A drawdown with all five sluice gates operated for 5 months would result in the release of less than 520 acre-feet to 1,250 acre-feet of sediment (Reclamation, 1999a). A precise number cannot be estimated because upstream channel scouring would vary with inflow volume and velocity, the number of sluice gates operated, the duration of operation, and with each subsequent sluice gate operation. With each subsequent use of the sluice gates, additional sediment from sediment redistribution during channel formation in Arrowrock Reservoir would be flushed from Arrowrock Reservoir but would be less than the initial operation during year 1.

Sediment samples from Arrowrock Reservoir bottom have been collected and analyzed for a broad spectrum of metals. The analysis shows that metal concentrations in the sediments are within normal ranges for sediment in the western United States (see appendix C). As a result, the resuspension of bottom sediments in Arrowrock Reservoir would not be expected to cause elevated concentrations of heavy metals in the water.

Water temperature of Arrowrock Reservoir during drawdown periods could be expected to vary with inflow temperature and solar radiation; however, temperatures would not likely rise above State standards. The travel time of water through Arrowrock Reservoir at elevation

3007 or 2975 feet can range from a few hours to approximately 6 days. Inflow temperature data collected during 1999 showed that the South Fork and Middle Fork Boise Rivers range from 0 °C to 17 °C. Temperatures of the South and Middle Forks appear to peak in late August or early September.

Existing data indicate some decrease in dissolved oxygen during late September and early October during normal reservoir operation. Under existing operations, Arrowrock Reservoir **turns over** in the fall and dissolved oxygen concentrations typically exceed 8.0 mg/L throughout the winter; the State standard is 6.0 mg/L. With a low pool elevation, water travel time through the reservoir would be short and the pool well mixed. As a result dissolved oxygen in Arrowrock Reservoir would reflect inflow concentrations which are not expected to drop below the Idaho State standard.

Lucky Peak Lake

Sediment concentrations in releases from Arrowrock Dam to Lucky Peak Lake under constant discharge, would exhibit two patterns–maintenance flushing, which is associated with the final drawdown of the reservoir and initial sluice gate operation and channel formation, which is associated with continuous sluice gate operation (see figure C-1). Data collected during the 1984 drawdown of Black Canyon Reservoir indicate that total suspended solids concentration downstream varied with inflow to the reservoir and sluice gate operation. Total suspended solids concentrations often exceeded 1,000 mg/L and peaked at 7,643 mg/L (see figures C-2, C-3, and additional discussion in Appendix C).

Inflow to Lucky Peak Lake could have concentrations of total suspended solids that exhibit patterns similar to those experienced downstream of Black Canyon Reservoir. Lucky Peak Lake would likely not be **stratified** during the drawdown, so turbidity levels and sediment deposition would be related to the Lucky Peak retention time, the magnitude of Arrowrock Reservoir discharge, and the duration of sluice gate operation.

Initial operation of Arrowrock Dam sluice gates would release a large amount of sediment into Lucky Peak Lake, but subsequent drawdowns would release less sediment. The majority of the flushed sediment would begin to deposit at the slack water of the pool. This water would be a mocha color comparable to that shown in figures 2-4 and 2-5. A portion of the flushed sediment would remain suspended, reach Lucky Peak Dam, and pass downstream into the Boise River. If all five sluice gates are operated for five months, approximately 520 to 1,250 acre-feet of sediment could move into Lucky Peak Lake. Of this amount approximately 235 to 705 acre-feet could be trapped in Lucky Peak Lake and the remainder could be flushed into the lower Boise River (Reclamation, 1999a). Subsequent drawdowns would flush much less sediment from Arrowrock Reservoir, and approximately 45 to 55 percent of the sediment flushed from Arrowrock Reservoir could be trapped in Lucky Peak Lake; the remainder could pass through to the lower Boise River. Table 3-8 summarizes potential movement of sediments under flood flow conditions. Under low flow conditions, less sediment would be flushed from Arrowrock and a higher percentage would be trapped in Lucky Peak Lake.

The high level of turbidity in Lucky Peak Lake during the maintenance drawdown would be visually obvious and exceed the Idaho standard for turbidity. It is anticipated that the turbidity would be spread vertically (surface to reservoir bottom) and laterally to most of the reservoir with the possible exception of the Mores Creek arm.

Table 3-8. No Action Alternative in Maintenance Season 3, Potential Sediment Movement From Arrowrock Reservoir and Deposition in Lucky Peak Lake (Assumes 5 sluice gates open continuously until full drawdown is achieved)

Sediment Flushed from Arrowrock Reservoir (Acre-Feet)	Sediment Trapped in Lucky Peak (Acre-Feet)		
	Fine Silts (<0.016 mm)	Coarse Silts (>0.016 mm)	Total
Minimum Wedge– 520 acre-feet			
5-year flood	145	150	295
10-year flood[1]	95	140	235
Maximum Wedge –1,250 acre-feet			
5-year flood	350	355	705
10-year flood[1]	235	355	570

[1]Note: A 10-year flood at Arrowrock Reservoir would result in more sediment swept through Lucky Peak Lake due to the larger flow if the flood event exceeds the travel time of Lucky Peak Lake

TDG saturation levels below Arrowrock Dam occasionally exceed Idaho State standards during periods of discharge from the upper Ensign valves. Under the No Action Alternative, TDG below Arrowrock Dam could continue to exceed State standards under some operational regimes using the upper Ensign valves.

Lower Boise River

During a maintenance drawdown, suspended sediment concentrations downstream of Lucky Peak Dam may exceed the TSS target set in the lower Boise River TMDL. Fine sediments that pass through Lucky Peak would most likely remain suspended throughout the Boise River. The water would be visually obvious with a mocha color that may obscure anything in the water. Water diverted from the Boise River for irrigation could have increased sediment levels and may affect some irrigation pumps, sprinkler systems, and other equipment operated in the Boise River system. Inflow to Lake Lowell could have an increased sediment load which would deposit in Lake Lowell. Lake Lowell turbidity could be higher than normal during the diversion of water from the Boise River.

Additional flow in the Boise River due to Arrowrock Dam outlet maintenance may move some of the previously accumulated sediment from the lower reaches of the Boise River and provide for positive future water quality and substrate impacts.

Anderson Ranch Reservoir

Although Anderson Ranch Reservoir elevation would be somewhat higher in some years, No Action would have no impact on the water quality of Anderson Ranch Reservoir.

South Fork Boise River

The No Action Alternative would have no water quality impacts to the South Fork Boise River

Mitigation and Residual Effects

Mitigation of water quality impacts due to No Action would not be practical, so all water quality effects would be residual impacts (see unavoidable impacts).

Alternative A (Preferred Alternative)

Use of the Arrowrock Dam sluice gates would be avoided to the extent possible. The gates would be used only if inflow exceeds the capacity of the available conduits and valves in the lower row of Ensign valves for 5 cumulative days during the third construction season or if stoplogs for the valves cannot be installed in a wet environment.

Arrowrock Reservoir

No water quality impacts are anticipated through the first two construction seasons.

The draft of Arrowrock Reservoir in Maintenance Season 3 to 3027 feet can be accomplished without the use of the sluice gates. The pool at elevation 3027 feet would contain about 1,500 acre-feet, much larger than a No Action maintenance drawdown but much smaller than the normal minimum operating pool of 19,100 acre-feet at elevation 3078.

Turbidity in the Arrowrock pool may increase due to sloughing of the unstable banks and redistribution of bottom sediments. After an undetermined period, most likely shorter than No Action, flow would clear with most turbidity limited to just upstream of the dam. Storms and strong winds could cause temporary increases in turbidity and total suspended solids in the Arrowrock residual pool due to erosion of channel areas below the normal operating pool elevation and sediment redistribution. However, the turbidity would rapidly decrease after the event.

Although the capacity of the operating valves increases during the construction period, so does the probability of the inflow to exceed the capacity of the operating valves. As a result, operation of the sluice gates may be necessary in the event the construction work site is flooded for more than 5 days between September 15 and March 1. The percent chance of using the sluice gates based on historical hydrology is: 15 percent for 5 total days, 12 percent for 5 consecutive days, 14 percent or 7 total days, and 9 percent for 7 consecutive days. The probability of flooding the work site for 5 days between September 15 and November 5 is less than 1 percent.

Figure C-4 (see appendix C) illustrates the probability of using the sluice gates over the total period from October 1 to March 1. Table 3-9 summarizes the probability of exceeding the sluice gate capability for 5 cumulative days or greater (probability of using the sluice gates). There is little chance that the sluice gates would be used during the irrigation season. It is most likely that if sluice gate operation becomes necessary, it would occur between November 6 and March 1.

Table 3-9. Alternative A (Preferred Alternative) Probability of Using Sluice Gates (Probability Inflow Would Exceed Discharge Capacity for 5 Cumulative Days or More)

Time Period	Probability
September 15 - November 5	1 percent or less
September 15 - March 1	15 percent

Operation of the sluice gates during Construction Season 3 drawdown could release approximately 1.5 to 2.0 acre-feet of sediment per sluice gate (Reclamation, 1999a). Most of the sediment sluiced would be from the reservoir bottom in the vicinity of the sluice gate with very little sediment from the lateral erosion in the upper reservoir. The residual pool behind Arrowrock Dam creates a pressure flushing situation in which a conical scour cone hole would form. This would be in contrast to the rather extensive scouring of the channel that would occur with a deeper drawdown as described for No Action maintenance years. As a result, turbidity in the Arrowrock pool would generally be low until the sluice gates are operated.

The overall volume of sediment flushed during Alternative A would depend on the number of sluice gates opened, the duration of operation, and the magnitude of the flow. If all five sluice gates were operated for 1 day at 4,300 cfs or greater, the total sediment flushed, due to scour cone formation, could be 8 to 10.5 acre-feet. A 5-year flood event during the Alternative A drawdown would cause considerably less sediment flush than during a complete drawdown with the No Action Alternative due to the larger pool with Alternative A.

Arrowrock pool would be shallow with a maximum depth of 37 feet near the dam. Water travel time through Arrowrock Reservoir would be less than 4 days at low flow conditions and would decrease to a few hours during high flow events. The short water travel time through Arrowrock would keep the pool well mixed. Thus, water temperatures of the pool would reflect inflow temperatures and would not be expected to exceed State standards. Dissolved oxygen concentrations would also reflect inflow concentrations which would not be expected to drop below the Idaho State standard.

Alternative A impacts to water quality in Arrowrock Reservoir would be somewhat less in magnitude compared to No Action.

Lucky Peak Lake

Through the first two construction seasons, Alternative A would have no effect on turbidity and total suspended solids in Lucky Peak Lake, however there may be some increase in TDG just downstream from the dam. Dissolved gas levels would be expected to increase somewhat during the first two construction seasons because water would be discharged from the upper Ensign valves of Arrowrock Dam and plunge into the backwater of Lucky Peak Lake rather than being discharged through the lower level valves. Alternative A would reduce the frequency of exceeding TDG standards over the long term, although a potential would still exist under flood control operations when submerged releases may cause surface turbulence and draw air to the depth of the valves, causing a TDG increase (Reclamation 1999b).

In Construction Season 3, there would be only a low probability (table 3-9) that the Arrowrock Dam sluice gates would be operated. Arrowrock Reservoir releases during the initial drawdown and during storms would have increased turbidity.

If the sluice gates are operated at an elevated discharge for 1 week or longer, up to 5.5 acre-feet of sediment released from Arrowrock Reservoir would be deposited in Lucky Peak Lake. If the sluice gates are not operated longer than the travel time through Lucky Peak Lake, the amount of sediment trapped in Lucky Peak would increase. Initial sluice gate operation would temporarily increase turbidity and the concentration of total suspended solids in Lucky Peak Lake. Suspended sediment would not spread throughout Lucky Peak Lake except in the unlikely event that the sluice gates are operated for a prolonged period. Table 3-10 summarizes the volumes of sediment that could be trapped in Lucky Peak under Alternative A.

Table 3-10. Alternative A (Preferred Alternative), Construction Season 3 Potential Sediment Movement From Arrowrock Reservoir and Deposition in Lucky Peak Lake With a 5-10 Year Flood[1]

Sediment Flushed from Arrowrock Reservoir (Acre-Feet)	Sediment Trapped in Lucky Peak (Acre-Feet)		
	Fine Silts (<0.016 mm)	Coarse Silts (>0.016 mm)	Total
Minimum Cone – 8.0 acre-feet	2.0	2.5	4.5
Maximum Cone – 10.5 acre-feet	2.5	3.0	5.5

[1]Assumes all five sluice gates are operated at the 5-10 year flow for longer than the travel time through Lucky Peak Lake (8-11 days)

There is a high probability that Alternative A impacts to water quality in Lucky Peak Lake would be negligible and, in the worst case, minor compared to No Action.

Lower Boise River

Alternative A would not impact water quality through the first two construction seasons and would have no impact to negligible impact in Construction Season 3 unless the Arrowrock sluice gates are not operated more than 5 days (15 percent chance). There is a low probability that the outflow of Lucky Peak Dam will have increased sediment as the result of Alternative A.

If the Arrowrock Dam sluice gates are operated and results in sediment passing Lucky Peak Dam, increased turbidity and total suspended solids in the Boise River could be noticeable. Any sediment that passes through Lucky Peak Lake would most likely be fine and would remain suspended throughout the Boise River system. The probability of this happening and of exceeding the TMDL targets for TSS in the Boise River would be small.

There is a less than 1 percent probability that the sluice gates would be used between September 15 and November 5. If sluice gate operation is required from October 1 to October 15 (the end of the irrigation season) and sediment passes through Lucky Peak Dam, water diverted for irrigation would carry increased suspended solids.

Water quality impacts to the lower Boise River would be negligible compared to No Action.

Anderson Ranch Reservoir

Anderson Ranch Reservoir water quality would not be impacted by Alternative A.

South Fork Boise River

Water quality in the South Fork Boise River would not be affected by Alternative A.

Mitigation and Residual Effects

On site actions are incorporated into Alternative A to mitigate potential water quality impacts including:

- Use of bulkheads in construction
- Partial drawdown to reduce pool erosion and downstream sediment release
- Alteration of Federal system storage and operation to minimize duration and frequency of sluice gate operation.

Alternative A conditions for sluice gate operation have been revised to further reduce potential for water quality impacts. Five cumulative work days lost due to flooding must occur before sluice gates are operated. This reduces the probability of sluice gate operation from 42 percent to 15 percent.

Reclamation, in coordination with IDEQ, IDFG, and USFWS would also monitor water quality in Arrowrock Reservoir prior to, during, and after construction. A preliminary Water Quality Monitoring Plan is included in Appendix C.

Alternative B

Through the first two construction seasons, Alternative B would be identical to Alternative A. During Construction Season 3, Arrowrock Dam sluice gates would be operated to draw the reservoir down to 3007 feet for 9 weeks.

Arrowrock Reservoir

The water quality of Arrowrock Reservoir would not be impacted through the first two construction seasons with Alternative B, the same as Alternative A.

Construction Season 3 drawdown to elevation 3007 feet would provide a 160-acre-foot pool which would have a maximum depth of 17 feet near the dam. The sluice gates would be used to drawdown Arrowrock Reservoir and to maintain reservoir elevation by passing inflows to Lucky Peak Lake. With the initial opening of the sluice gates, a significant amount of sediment would flush out of Arrowrock Reservoir due to channel formation just upstream of the sluice gates. The volume of sediment flushed under Alternative B would be much greater than for Alternative A, but less than a No Action maintenance drawdown because the sluice gates would be operated for only 9 weeks.

Turbidity level in the residual pool would increase, sediment in Arrowrock Reservoir would redistribute and work toward the dam, and temporary increases in turbidity would occur with storm events. Unstable banks would form from the cutting action through the fine sediment and would continue to slough fine sediment contributing to turbid water in the residual pool and in Arrowrock Dam releases. TSS concentrations in Arrowrock Reservoir releases would exhibit maintenance flushing and channel formation patterns (see figure C-1).

Water temperature and dissolved oxygen concentrations would be similar to that described for the No Action Alternative and would not violate Idaho State standards. However, increased flow from the South Fork Boise River during September in Construction Season 3 would increase sediment redistribution from the upper reaches of Arrowrock Reservoir and increase turbidity in the residual pool.

Alternative B water quality effects for Construction Season 3 in Arrowrock Reservoir would be generally similar or less adverse than a No Action maintenance year but would last for only 9 weeks compared to 5 months for the No Action and would not be recurring as for No Action. Alternative B effects would be substantially greater than the effects of Alternative A.

Lucky Peak Lake

Through the first two construction seasons, Alternative B effects would be the same as Alternative A. Water quality in Lucky Peak would not likely be impacted during this period.

In Construction Season 3, operation of the sluice gates at Arrowrock Dam would move somewhat less than the maximum of 1,250 acre-feet of sediment projected for the No Action Alternative under high flow discharge. About 45-55 percent of the sediment would be trapped in

Lucky Peak Lake if the flow duration exceeds the travel time of Lucky Peak Lake. Most sediment would immediately begin to settle out in Lucky Peak Lake. Inflow to Lucky Peak could have a concentration of total suspended solids similar to Black Canyon releases during sluice gate operations (figures C-2 and C-3) and could be distributed vertically and laterally. Turbidity and total suspended solids levels are related to the Lucky Peak retention time, Lucky Peak operation, magnitude of discharge, duration of sluice gate operation, and would likely exceed the Idaho standard for turbidity.

Alternative B sedimentation and suspended sediment impacts (Construction Season 3) in Lucky Peak Lake, although generally similar or less intense than a No Action maintenance year, would last for only 9 weeks compared to 5 months for the No Action and would not be recurring. Alternative B water quality impacts would be greater than Alternative A impacts.

Alternative B would also have the same long-term potential for reducing TDG as Alternative A.

Lower Boise River

Alternative B impacts through the first two construction season would be identical to Alternative A.

In Construction Season 3, fine sediment that passes through Lucky Peak Dam would most likely remain suspended in the Boise River and irrigation waters and would be highly visible and have a mocha color (the same as No Action). Turbidity and TSS concentration in the Lower Boise River would be the same as No Action and would likely exceed the targets set in the Lower Boise River TMDL and the Idaho State standard for turbidity.

Under Alternative B, flow in the Boise River during July and August would be higher than with Alternative A and No Action due to the earlier drawdown of Arrowrock Reservoir. From November to March, flows with Alternative B would be lower than flows in Maintenance Season 3 for No Action due to a shorter drawdown and earlier refill of Arrowrock and Lucky Peak after November 7. Diversions made for irrigation and for refill of Lake Lowell would contain increased turbidity and suspended sediment levels.

Alternative B water quality impacts (Construction Season 3) would be generally similar or slightly less adverse than a No Action maintenance year but would last for only 9 weeks compared to 5 months for No Action and would not be recurring. Alternative B water quality impacts would be much greater than Alternative A impacts.

Anderson Ranch Reservoir

Alternative B would not impact the water quality of Anderson Ranch Reservoir, the same as No Action and Alternative A.

South Fork Boise River

Alternative B would have no effect on water quality of the South Fork Boise River through the second construction season. In Construction Season 3, more of the late season irrigation demands would be met using Anderson Ranch Reservoir during September and early October. The increased volume of water may lower water temperatures in the lower stretch of the river compared to No Action Alternative and Alternative A. This would be a positive water quality effect.

Mitigation and Residual Effects

No mitigation measures impacts were identified. As a result, all water quality impacts of Alternative B would be a residual effect.

Fish

Affected Environment

The normal operations of the Boise Project affects the aquatic habitat, and water level fluctuations in freshwater systems act as disturbances in the landscape. Annual variations in water level have prevented establishment of aquatic plants and normal operations are not always favorable for fish and aquatic organisms. Annual drawdown for flood control and irrigation operations, along with unfavorable soil types and steep slopes, have precluded development of **riparian** vegetation along the periphery of Arrowrock Reservoir and Lucky Peak Lake.

Arrowrock Reservoir

Despite water level fluctuations, the three Boise River Reservoirs and the river reaches downstream provide significant regional fisheries. Arrowrock Reservoir provides a mixed fishery supported by cold and warm water fish species including rainbow trout, mountain whitefish, bull trout, smallmouth bass, and yellow perch. The rainbow trout fishery is supported primarily by stocking, although some wild redband trout are present. From 1996 to 1998, the IDFG stocked Arrowrock Reservoir with an average of about 120,000 rainbow trout fingerlings, 15,000 Kamloops/steelhead hybrids, and 8,000 fall chinook salmon fingerlings (USFWS, 1999). Nongame fish species include mottled sculpin, speckled dace, shiners, bridgelip and largescale suckers, and northern pikeminnow.

IDFG manages Arrowrock as a general fishery for rainbow trout and a conservation fishery for bull trout on which no harvest is allowed. IDFG's management direction for Arrowrock under the 1996-2000 Fisheries Management Plan is to (1) seek a minimum fishery conservation pool through coordination with Reclamation and (2) stock the reservoir annually with fingerling rainbow trout.

Currently, drawdown of Arrowrock during normal operations negatively impacts development of the food base for fish, limits spawning habitat for warmwater fish, exposes nests and kills eggs, and causes fish to move into Lucky Peak Lake. These effects, in combination, reduce the capacity of Arrowrock Reservoir to support a sport fishery. A conservation pool of 28,700 acre-feet was recommended to increase fish habitat and winter carryover of rainbow trout (Wolfin and Ray, 1984). This pool is based on an elevation of 3078 feet. New area capacity curves show that this elevation actually provides a pool of only 19,100 acre-feet.

Lucky Peak Lake

Lucky Peak Lake provides a "two-story" fishery with smallmouth bass occupying the warm, inshore waters and rainbow trout and kokanee dominating the cold, mid-water fishery (IDFG, 1995). Other species present include yellow perch, bull trout, and mountain whitefish as well as a variety of nongame species. Harvest of bull trout is not allowed in Lucky Peak Lake or other Idaho waters. The rainbow and kokanee fisheries at Lucky Peak are supported through stocking by IDFG and entrainment of fish in Arrowrock Dam releases. Spawning conditions for

warmwater fish are better at Lucky Peak Lake than at Arrowrock Reservoir because the reservoir level is usually stable throughout the summer.

On occasion, TDG saturation levels below Arrowrock Dam during periods of discharge from the upper Ensign valves exceed the Idaho State standard. Fish kills have not been documented (IDFG, 2000a).

Boise River Downstream of Lucky Peak Dam

A variety of gamefish including rainbow trout, brown trout and mountain whitefish are found in the Boise River downstream from Lucky Peak Dam. Some naturally reproducing brown trout are present, and the IDFG stocks the river with rainbow trout between Barber Park and Star. Nongame, native fish include suckers, chiselmouth, and northern pikeminnow. In the reach downstream of Star, warmwater species such as largemouth bass, smallmouth bass, and channel catfish, all of which can better withstand the poor water quality found in that reach, are most common.

Lake Lowell, an offstream reservoir located west of the city of Boise, is popular for its fishery. This reservoir is filled by diversions to the New York Canal from the Boise River at Boise River Diversion Dam. The fishery consists primarily of largemouth bass, smallmouth bass, yellow perch, black crappie, bullhead, bluegill, and channel catfish. Angler use generally increases around mid-May, with bass being caught in flooded vegetation. Crappie and bluegill action follows as water temperatures rise.

Anderson Ranch Reservoir and South Fork Boise River

A variety of game fish, including rainbow trout, bull trout, smallmouth bass, yellow perch, and kokanee, are found in Anderson Ranch Reservoir. Rainbow trout include both wild and hatchery stocks; hatchery fingerlings and catchable size fish are stocked in the reservoir. Wild fish move downstream into the reservoir during early spring and late fall. Both hatchery and wild rainbow trout can grow to 5 pounds or more. Kokanee find good spawning conditions in streams tributary to Anderson Ranch Reservoir.

The South Fork Boise River reach from Anderson Ranch Dam to Arrowrock Reservoir is famous for wild rainbow trout and was designated as a quality trout stream by IDFG in 1978. IDFG manages the trophy rainbow fishery with size and tackle restrictions and a limited season. Mountain whitefish are also taken by anglers in this reach and are an important gamefish, particularly in late fall and winter.

Environmental Consequences

This discussion of fish impacts excludes bull trout which is discussed in the Threatened and Endangered Species section. None of the alternatives would have a measurable impact on the aquatic resources of Anderson Ranch Reservoir.

Impact Indicators/Methods for Evaluating Impacts

The primary factors that impact fish include the following:

- Water flows, depths, and fluctuations
- Water temperature
- Oxygen content and TDG
- Nutrient content and turbidity

The basic assumptions for this analysis are that streamflow and reservoir content are directly linked to quantity and quality of fish habitat and fish habitat is linked to the health and productivity of fish populations. As a result, the analysis focuses on fish habitat including reservoir content, water quality, streamflows, and fishery rearing conditions.

Data used for this analysis include basic information on fish populations and movements, recommended conservation pools and minimum streamflows for fish, and other physical parameters that could impact aquatic organisms. These data were compared with the reservoir levels and streamflows generated by computer modeling and potential water quality effects of the alternatives. Resident trout spawning and rearing in reservoir and riverine environments were used as indicator fish habitat for this analysis.

Turbidity and suspended sediment are considered to be one of the more important impact indicators for this analysis. The effects of suspended sediment on fish will vary with life stage, species, concentration of suspended sediments, duration of exposure, and suspended sediment particle size and shape. Early life history stages are most sensitive. Adult fish can withstand higher TSS concentrations and longer durations of exposure.

Although moderate and lower turbidity concentrations may not be lethal to fish, fish species that feed on suckers, whitefish, and other fish may have a difficult time locating prey. The inability of fish to feed during extended periods of time could result in weight loss. If turbid conditions prevail for an extended period of time, fish may move to a more suitable environment if available.

Specific TSS concentrations in reservoirs and river reaches cannot be predicted because of several unknown variables that influence sediment transport. However, predictions for broad ranges of TSS concentrations have been made based on data from Black Canyon and American Falls Reservoirs (see appendix C), TSS predictions from similar reservoir drawdown analysis (Elwah River Ecosystem Restoration Implementation DEIS), and observations and video of the last maintenance drawdown of Arrowrock Reservoir in 1987 and in other low water levels during drought years.

Several studies have assessed the effects of fine sediment on salmonid populations. Direct effects of suspended sediments on fish begin to be observed at 50-100 mg/L, while lethal and sublethal effects from acute exposure (less than 4 days) occur at concentrations of 10,000-100,000 mg/L and from chronic (6 weeks or more) exposure up to 1,000 mg/L (Olympic

National Park, 1996). Chronic exposures to concentrations greater than 100 mg/L impaired feeding and caused reductions in growth rates and avoidance.

Despite evidence of adverse effects from high concentrations of suspended sediment, fish often survive in naturally turbid environments, i.e., bull trout migrating up the Boise River during turbid spring runoff conditions.

No Action Alternative

Drawdowns of Arrowrock Reservoir and Lucky Peak Lake would occur in Maintenance Season 1, 3, and every sixth year thereafter for a total of 9 drawdowns in a 50 year period. Arrowrock Dam sluice gates would be used during each drawdown and large amounts of sediment would be released downstream. Fishery effects described for No Action would be expected to occur every 6 years following Maintenance Season 3.

Arrowrock Reservoir

Drafting Arrowrock Reservoir to extremely low levels (elevation 3007 feet) or to streambed (elevation 2975 feet) would result in the temporary loss of most of the reservoir habitat. Although a pool of about 160 acre-feet would remain at elevation 3007 feet, it is expected that most fish would pass into Lucky Peak Lake due to the small pool, water turbidity, and run-of-river condition.

Fish may be stranded immediately upstream of Arrowrock Dam, as evidenced by video footage taken during the 1987 inspection of the valves and reservoir drawdown to elevation 2975 feet. Some fish might attempt to hold in the residual pool at elevation 3007 but conditions would most likely be unsuitable and fish mortality could be expected. Some fish might move up into the Middle and/or South Fork Boise River where more favorable conditions are present.

Under the No Action, Arrowrock Reservoir will initially experience TSS levels of 10,000-100,000 mg/L for more than 4 days which would be lethal to most fish species that are in the area of Arrowrock Dam. This high level of turbidity (and subsequent fish kill) is based on video footage take during the last drawdown of Arrowrock Reservoir when extremely turbid conditions resulted in fish mortalities near Arrowrock Dam. TSS concentrations should be highest during the final stages of drawdown and subside to less than 1,000 mg/L after the majority of sediment has been flushed from Arrowrock Reservoir.

Under the No Action Alternative, the reservoir fishery would be essentially eliminated in the year of the maintenance drawdown. There would be a chronic and acute impact to fish every sixth year after Maintenance Season 3. Recovery of the reservoir trout fishery with normal stocking rates by the IDFG would take 2 to 3 years. Other fish would require 1-4 years for recovery.

Lucky Peak Lake

To reduce potential entrainment of fish through Lucky Peak Dam into the Boise River and to maintain sufficient aquatic habitat, an effort would be made to maintain the level of Lucky Peak Lake above elevation 2957. This effort would likely not succeed under extremely dry or wet years. Maintenance at this level would be near normal baseline conditions for Lucky Peak Lake.

TSS concentrations in Lucky Peak Lake near Arrowrock Dam will be highest during the final stages of drafting Arrowrock Reservoir. Conditions near Arrowrock Dam will most likely range from 1,000 to 10,000 mg/L for more than 6 weeks and result in fish mortality. However, TSS levels throughout the remainder of Lucky Peak Lake should be less than 1,000 mg/L (as a result of the residual pool) and not result in fish mortality.

Maintenance of Lucky Peak Lake at elevation 2957 should lessen the impact of large amounts of sediment flushed into the reservoir. Fish would also have the opportunity to move to some areas of Lucky Peak Lake (such as the Moores Creek arm) which may provide a more suitable environment with little to no water quality impacts as compared to the main body of Lucky Peak Lake. Depending on hydrologic conditions, rearing and feeding habitat conditions would rapidly improve after the maintenance drawdown.

No Action would have no effect on the potential for exceeding TDG standards.

Lower Boise River

During maintenance years sediment flushed through the Arrowrock sluice gates for an extended period would reach the lower Boise River and would likely exceed turbidity standard and TMDL targets. TSS levels of 1,000 to 10,000 mg/l could be exceeded causing fish mortality early in the period of sluice gate operation. Longer term exposure at lower levels (200-1,000mg/l) would cause weight loss and stress in fish throughout the maintenance drawdown period. Increase winter streamflows could have a slight beneficial effect with an increase in wetted habitat.

Mountain whitefish, which spawn generally from mid- to late November into early December (IDFG, 2000a), may be affected as a result of turbid water (unable to visually find a mate). However, there should be negligible impacts to incubating eggs as the majority of sediments passing Lucky Peak Dam would remain in suspension.

Higher levels of turbidity of the inflow to Lake Lowell could reduce fish foraging efficiency and adversely impact the Lake Lowell fishery.

South Fork Boise River

Releases from Anderson Ranch Dam would be near those experienced during normal operations. Flow alterations of the South Fork as the result of No Action would not be expected to adversely impact redband trout or other fish.

Mitigation and Residual Effects

Drawdown of Arrowrock Reservoir to near empty would result in the nearly complete loss of the reservoir fishery every 6 years. The IDFG annually stocks Arrowrock with fish to "restore and maintain" the fishery for anglers. Stocking rates have been fairly consistent, regardless of whether or not Arrowrock Reservoir was drawn down for maintenance activities or drought.

Under the No Action Alternative, Reclamation would coordinate with the IDFG to augment the stocking following maintenance years. However, stocking of fish would not immediately replace larger sized trout that inhabited Arrowrock prior to drawdown and it would take about 2-3 years to restore the larger size class of trout lost with a complete drawdown

Alternative A (Preferred Alternative)

Alternative A would have no effect or negligible effect on fish and aquatic resources through the first two construction seasons. As a result, the discussion below is limited to the third construction season.

Arrowrock Reservoir

In Construction Season 3, the remaining pool at elevation 3027 would be about 1,500 acre-feet covering about 135 acres. The residual pool would extend about 3 river miles upstream and would range in depth from 37 feet near the dam to 18-25 feet midway through the pool and decreasing further upstream.

Turbidity in the Arrowrock pool during and following drawdown to 3027 feet would increase due to sloughing of the unstable banks and redistribution of bottom sediments. After an undetermined period, inflow to the residual pool would clear with most turbidity limited to just upstream of the dam. These increases in turbidity during and following drawdown to elevation 3027 feet could result in fish mortalities. However, during drought years in1989 and 1991 when similar reservoir levels were reached during August and September for over two weeks, no fish kills were reported. Adverse effects to fish from turbidity and TSS would be much less for Alternative A than for No Action.

Significant numbers of fish would be entrained through Arrowrock Dam into Lucky Peak Lake during the drawdown. It is possible that nearly all rainbow trout could be entrained; however, bottom-dwelling species such as suckers and chiselmouth would be more likely to remain in the residual pool. Additional information is in Appendix I. Stranding is possible, but much less likely than during complete drawdown under No Action.

While there has not been a study specifically on fish mortality associated with entrainment through Arrowrock Dam, trap and haul, and radio telemetry work by IDFG and Reclamation have not documented any significant harm to fish. This is based on the condition of fish that passed through the ensign valves and were subsequently recaptured in Lucky Peak Lake. Fish that are entrained into Lucky Peak Lake during year three drawdown (elevation 3027 feet) must pass through the lower ensign valve trashracks. These have 6.25 inch spacing between bars.

Based on the area of the trashrack in front of each middle row of valves and assuming a 260 cfs release per valve, the estimated approach velocity at the trashrack surface will be 0.79 feet per second when the reservoir is at elevation of 3027 feet. Bell (1990) indicated that the minimal cruising speed that can be maintained for long periods of time (hours) is greater than 1 foot per second for adult and juvenile fish of species similar to those found in Arrowrock Reservoir. Sustained and darting speeds are typically greater than 2-3 feet per second. Based on the surface area of the trashracks in front of each valve and estimated minimal cruising speeds for most fish of at least 1 foot per second, it is likely that fish can either pass through the 6.25 inch openings, or avoid them completely.

During the third construction season, fish passing through the lower row of ensign valves would drop a distance of approximately 25-35 feet initially (until 9/15) and 55-65 feet after 9/15. Physical damage to fish from contact with the face of the dam could occur as fish are expelled from the ensign valves. However, no fish kills have been documented when similar such releases have occurred in the past.

The fishery effects of Alternative A are a one time event and not as adverse as the effects of even a single maintenance drawdown under No Action.

Downstream releases through the new clamshell gates would, on average, be made at a greater water depth than in the past. In the long term, entrainment of fish through Arrowrock Dam would be expected to be lower in future years. Although there have been no entrainment studies at Arrowrock Dam on rainbow trout, it is speculated that entrainment rates of rainbow trout, as well as other fish in Arrowrock Reservoir, would be similar (low) to that of Anderson Ranch Dam. Entrainment of fish at Anderson Ranch Dam is thought to be low as a result of the greater water depth over the outlets. This is evidenced by the absence of Anderson Ranch Reservoir radio tagged bull trout downstream of Anderson Ranch Dam (IDFG, 2000b).

Lucky Peak Lake

Under Alternative A, the target pool elevation of 2957, to reduce fish entrainment and loss to the lower Boise River, could not be strictly maintained early in the construction season. In an average water year, Lucky Peak would be drafted below the target elevation by October 15, but would refill to elevation 2957 by October 31. During a wet year, less water would be drafted from Lucky Peak as inflows would be higher. The space would also refill quicker after October 15 for the same reason. During a dry period, it may be impossible to sustain a minimum pool in Lucky Peak at elevation 2957 and deliver irrigation water late in the season.

If the sluice gates are not operated, TSS levels in Lucky Peak Lake should be less than 200 mg/L throughout the third construction season and not impact the fishery. There is a 15 percent chance that the sluice gates would be used during the third construction period and less than 1 percent probability that they would be operated between September 15 and November 5.

If the sluice gates are operated, TSS concentrations in Lucky Peak Lake in the vicinity of Arrowrock Dam would initially be high (1,000-10,000 mg/L) but would not last longer than 4 days. Fish mortality may occur near Arrowrock Dam during the period when the gates are first

opened. Peak sediment concentrations would be reached rapidly in the upper part of Lucky Peak Lake (between Spring Shores Marina and Arrowrock Dam), but the effect would be short term. TSS in the remainder of Lucky Peak Lake should not be near lethal levels for fish. TSS levels with subsequent sluice gate operations, if needed, should be less than that accompanying initial opening of the sluice gates.

Alternative A impacts to fish in Lucky Peak in Construction Season 3 would be minor compared to even a single maintenance drawdown under No Action.

Over the long term, Alternative A reduces fish adverse effects, sediment movement into the reservoir, and TDG levels that exceeds the Idaho State standard (use of low level outlets). These would be accompanied by a reduced potential for harm to fish.

Lower Boise River

It is highly unlikely that TSS levels would be affected in the lower Boise River. As a result, adverse effect to fish would not be expected. Alternative A fishery effects would be minimal and increased flows could perhaps be beneficial to fish as the result of increased and improved wetted habitat from September through February.

If the Arrowrock Dam sluice gates are not operated continuously for more than 7 days during the irrigation season, the Lake Lowell fishery would not be affected. If the gates are operated longer, the small volume of sediment reaching Lake Lowell would have a minimal impact on the fishery consisting of a temporary decreases in foraging efficiencies. Thee probability of the sluice gates being operated during the irrigation season is less than 1 percent.

Alternative A would have substantially less impact on fish than No Action.

South Fork Boise River

Streamflow targets identified for fish would be met, resulting in no streamflow impacts to fish.

Mitigation and Residual Effects

The decision to allow up to 5 days of flooding of the upstream work area in Construction Season 3 would reduce the probability of sluice gate use and associated water quality impacts to fish in Arrowrock Reservoir, Lucky Peak Lake, and the lower Boise River. The probability of using the sluice gates would drop from 42 percent to 15 percent.

Reclamation has agreed to reimburse IDFG for restocking of Arrowrock Reservoir with 180,000 rainbow trout fingerlings, 140,000 rainbow catchables and 77,500 kokanee fingerlings after construction. See comment letter 1A and Reclamation's response.

Although these fish should grow quickly there may a period of 2 to 3 years before the sport fishery is fully restored.

Alternative B

Alternative B would have no effect or negligible effect on fish and aquatic resources through the first two construction seasons, identical to Alternative A. As a result, the discussion below is limited to the third construction season.

Arrowrock Reservoir

Alternative B effects on the Arrowrock Reservoir fishery would be similar to a single No Action maintenance drawdown. That is, the reservoir fishery would be essentially eliminated for a period of time. Recovery of the reservoir trout fishery with normal stocking rates by the IDFG would take 2 to 3 years. Other fish populations would take 1-4 years to recover. However, the shorter drawdown period could potentially shorten the period of recovery for some fish species compared to No Action.

In the short term, Alternative B effects on the reservoir fishery would be substantially more adverse compared to Alternative A. However, long-term fishery benefits would be the same as for Alternative A.

Lucky Peak Lake

Maintenance of Lucky Peak Lake at the requested level of 2957 feet would be about the same as for Alternatives A and No Action.

Alternative B short-term impacts to the fish community would be similar to that of a single No Action maintenance drawdown, but would be for a shorter period of time and would be a single event. In the short-term, Alternative B impacts would be considerably greater than the impacts of Alternative A.

Long-term fishery benefits would be the same as for Alternative A since no further drawdowns would be needed for maintenance.

Lower Boise River

Although the flow regime with Alternative B would be different from other alternatives due to earlier drawdown, shorter length, and greater flows in the late summer, fish impacts would be similar but less than a single maintenance drawdown for No Action. Changes in flow regime would be minimal, perhaps beneficial due to increased wetted habitat. Turbidity effects would be the same as described for No Action but would extend over a shorter period. Increased turbidity and TSS levels would likely inhibit the ability of fish to feed and may result in fish mortality. Whitefish spawning activities could be adversely affected (limited) as a result of increased turbidity. These effects would be the same as for No Action but would occur over a shorter period (9 weeks compared to 5 months).

Impacts to the Lake Lowell fishery would be the same as for a single No Action maintenance drawdown but would be for a shorter period.

All fishery impacts under Alternative B would be greater than under Alternative A which would have no or negligible impacts to fish in this river reach.

South Fork Boise River

Flows of the South Fork Boise River during September of the third construction season would be higher under Alternative B than the other alternatives. However, Alternative B would most likely not have any adverse impacts to juvenile and adult salmonids. The impacts of Alternative B are expected to be similar to No Action and Alternative A, i.e., no effect or negligible effect.

Mitigation and Residual Effects

Mitigation would be the same as for No Action. Residual effects would be greater than for Alternative A but less than for No Action.

Vegetation and Wildlife

Affected Environment

Vegetation

Vegetation on the hills around the Boise River reservoirs generally consists of a sagebrush steppe community. Fluctuating water levels and steep sided slopes inhibit the establishment of permanent riparian habitat along much of the reservoir shoreline. Small pockets of riparian vegetation have developed along the high water line, but most of the riparian habitat is along the tributary streams that enter the reservoir. These riparian areas are mostly comprised of shrubby willows. At Anderson Ranch, ponderosa pine, Douglas fir, and aspen grow in pockets mostly on north- and east-facing slopes. Vegetation below the highwater line of the reservoirs consists primarily of weedy annuals.

The typical plant community along the river reaches downstream from Anderson Ranch Dam and Lucky Peak Dam is black cottonwood forest. An understory exists consisting primarily of alder, birch, hawthorn, and other shrubs. Exotics such as Russian olive are also present in the lower reaches of the river. Seasonally flooded wetlands typically are vegetated with sedges, rushes, spikerush, cattail, and bulrush.

The entire riparian zone in the project area has been altered by reservoir operations for flood control and irrigation and by channel alteration primarily near the more developed and populated areas. The upstream reservoirs (1) collect and prevent downstream movement of streambed sediments and (2) decrease peak floodflows that historically scoured side channels and built gravel bars and islands in the river. These bars are necessary to establish new cottonwood communities. The riparian community along the reach downstream of Lucky Peak Dam is limited to a narrow band of black cottonwood forest which lies between developed areas and normal high water line. The cottonwood forest is dominated by relatively mature trees with little understory or recruitment of young trees.

Wildlife

Lands surrounding Arrowrock Reservoir and Lucky Peak Lake are important transitional and wintering habitats for migratory herds of mule deer and elk. South-facing slopes remain relatively free of snow for much of the winter and contain important winter forage such as bitterbrush. Occasionally, deer attempt to cross the reservoirs when the ice is thin, fall in, and are unable to escape. This happens in random areas except in the Mores Creek arm of Lucky Peak Lake and near Cottonwood Creek on Arrowrock Reservoir where the occurrence is more frequent.

Waterfowl and shorebirds use the reservoirs in significant numbers year-round. Upland birds, such as chukar partridge, gray partridge, and California quail inhabit the steep slopes above the reservoirs and the riparian areas adjacent to the reservoir.

More than 150 species of birds, 37 species of mammals, and a variety of reptiles and amphibians are found along the river. The area serves as an important breeding and wintering area for waterfowl. Many of the bird species that nest along the river are neotropical migrants traveling as far south as Central and South America for the winter.

Environmental Consequences

Analysis of the hydrologic findings indicates that impacts to vegetation would be minimal. Due to the general lack of vegetation in the construction areas, adverse impact to vegetation at the construction site would be unlikely. If any vegetation is lost at the construction site, the contractor would be required to replace the loss.

Impact Indicators/Methods for Evaluating Impacts

The effects analysis for vegetation and wildlife is based on an analysis of the hydrologic effects of the alternatives (reservoir elevations and riverflows), available information on vegetation along reservoirs shores and river banks, available information on wildlife movement and the wildlife habitat, and the potential effects of reservoir and streamflow changes on wildlife habitat. Although an estimate of changes in the amount of habitat is possible, there are no data on numbers of wildlife using a particular habitat. As a result, the analysis of wildlife impacts can only be qualitative.

Major factors with the potential to affect vegetation and wildlife are reservoir drawdowns, water turbidity and sediment deposition, and altered riverflows, particularly higher riverflows.

No Action

Maintenance activities of No Action have the potential to affect vegetation and wildlife in Maintenance Season 1 and 3 and every sixth year thereafter.

Arrowrock Reservoir

The sparse riparian vegetation at Arrowrock Reservoir is always well above the reservoir water surface in much of the growing season. Greater drawdowns in maintenance years with the No Action would not be expected to affect the vegetation along the shoreline of Arrowrock Reservoir. Tributary flows that sustain much of the riparian communities would be unchanged.

It is likely that the top of Arrowrock Dam will be used as the staging area and there would be no associated vegetation loss.

Wildlife that would be most affected by the operational changes would be waterfowl which normally use the open water of Arrowrock Reservoir for resting and feeding, especially during the fall migration. Arrowrock Reservoir normally has a pool surface of about 700 acres at the end of October and a pool surface of 2,500 acres at the end of February. No Action maintenance drawdowns would reduce the pool surface to 30 acres or eliminate it entirely (run-of-river) in alternate maintenance drawdowns during October through February. A smaller winter pool may

be more susceptible to icing which would further reduce waterfowl habitat. However waterfowl displaced from the Arrowrock pool would likely move to Lucky Peak Lake where there would be a substantial winter pool.

The periodic deep drawdowns under the No Action may limit primary productivity. This would adversely affect the fish and other aquatic organisms used as prey by birds such as herons, osprey, and some species of waterfowl. Turbidity could also adversely affect the foraging capability of these birds. However, the drawdowns may actually increase foraging opportunities for migrating shorebirds in the fall as more mudflats than normal would be available. Fish eating wildlife could benefit in the short term with the concentration of prey and the availability of dead fish.

The small winter pool in maintenance drawdown years would reduce ice hazards to mule deer. Deer would be unlikely to cross the extremely small pool to fall through thin ice. Exposed mudflats would have time to dry between October and mid-November when deer typically arrive on the winter range and would not pose an additional hazard.

Construction would disturb wildlife, especially wintering deer, which would temporarily move out of the area. This disturbance would be localized and short term and would not be significant.

Upland gamebirds or other wildlife using upland and riparian habitat would not be affected.

Lucky Peak Lake

No Action maintenance drawdowns would have no direct effect on the sparse riparian vegetation around Lucky Peak Lake since the pool would remain full for most of the growing season and tributary streamflow would continue to support the larger riparian areas.

Under No Action, Lucky Peak Lake would have a winter pool surface of about 1,500 acres in maintenance years. This compares with a normal pool surface of 1,300 acres at the end of October and a pool surface of 1,600 acres in February. The 1,500-acre pool would provide ample resting and feeding habitat for waterfowl, including those that would normally use Arrowrock Reservoir.

Under No Action, forage for wildlife that rely on fish as prey would probably not be diminished, as many of the fish from Arrowrock would be entrained into Lucky Peak Lake. However, turbidity from sediment flushing through Arrowrock Dam may inhibit the ability of wildlife to find and capture fish.

Deer mortality due to falling through ice would continue unchanged as areas where deer typically cross the ice would be inundated in all years. Upland gamebirds or other wildlife using upland habitat would not be affected.

Lower Boise River

Higher than normal river flows from November through February during maintenance years. Riparian plant communities would not be affected as the flow would be within normal operating ranges, although the timing of the higher flows would be atypical. Increased suspended sediment concentrations would have no effect on plants.

Waterfowl nesting would not be affected as the higher winter flows would cease at the end of February, prior to the onset of nesting. Flow increases in late summer are not likely to have any substantial effect on wildlife. Turbidity in the river may inhibit winter foraging by fish-eating birds such as herons, osprey, and kingfishers; these effects would be greater in years when Arrowrock Reservoir is drawn down to a run-of-river condition and would be less in maintenance years when a pool of 160 acre-feet is maintained.

Anderson Ranch Reservoir/South Fork Boise River

No Action would have no measurable effect on vegetation or wildlife at Anderson Ranch Reservoir and along the South Fork Boise River.

Mitigation and Residual Effects

If any areas are disturbed or cleared for maintenance staging, those areas would be reseeded with native plants. Residual effects would remain for a period of 5 years.

Loss of open water habitat at Arrowrock Reservoir during the winter would displace waterfowl but would be compensated by the ample surface area of Lucky Peak just downstream. All impacts would be minor, and mitigation or replacement of lost open water habitat would not be practical.

Alternative A (Preferred Alternative)

Arrowrock Reservoir

As in No Action, there would be no effect to vegetation from reservoir drawdown. Impacts to vegetation in the vicinity of Arrowrock Dam would be limited to a minor amount of clearing for equipment and materials at the staging area and for disposal of waste concrete. Staging and disposal areas would be chosen to avoid riparian areas and the disposal area would be above the highwater mark.

Although the Construction Season 3 pool would be small (about 135 surface acres) and could ice up earlier than normal it would provide a larger resting and feeding habitat for waterfowl than under a No Action maintenance year. Turbidity in the pool could discourage waterfowl use, but would also be less than with No Action.

Reduced biological productivity would decrease aquatic organisms and prey for some wildlife species but would not be as greatly reduced as a No Action maintenance year and would be a

one-time event. Shorebirds would likely take advantage of exposed mudflats during the fall and may benefit from the change in operation. The exposed sediments would either dry or freeze and create a solid surface for migrating deer.

Upland vegetation loss associated with the construction staging and waste disposal areas shown in figure 2-8 would be minor.

Lucky Peak Lake

The earlier drawdown of Lucky Peak Lake over the three construction seasons is not likely to affect the riparian vegetation around the lake since the lake would remain at full pool for most of the growing season and tributary streamflow would continue to support the larger riparian areas (the same as No Action maintenance years).

Alternative A effects on wildlife that rely on fish as prey would be negligible compared to No Action as turbidity in Lucky Peak Lake would be much less even if the sluice gates were used. There would be no effects on deer, gamebirds, and wildlife using upland habitat, the same as No Action.

Anderson Ranch Reservoir and South Fork Boise River

Alternative A would have no measurable effect on vegetation or wildlife at Anderson Ranch Reservoir and along the South Fork Boise River (the same as No Action).

Mitigation and Residual Effect

Areas disturbed and cleared for construction staging and disposal of concrete waste would be reseeded.

Impacts to wildlife are related to the reduction of open water habitat for waterfowl during a single November through February period. Replacement of the minor and short term loss of open water habitat would not be practical, and no mitigation was identified or proposed. All of the wildlife effects would be residual effects.

Alternative B

Alternative B effects on vegetation and wildlife would be identical to Alternative A through the first two construction seasons. As a result the effects identified below are for Alternative B Construction Season 3 only.

Arrowrock Reservoir

The Construction Season 3 drawdown under Alternative B would reduce open water habitat for waterfowl similar to a No Action maintenance drawdown. However, the drawdown under Alternative B would be shorter and a single event, resulting in less impact than No Action. Alternative B effects on open water habitat would be greater than Alternative A for a period of

time. After completion of construction in November, the pool would rapidly fill and surpass the size of the Alternative A pool.

Effects of staging and disposal areas for Alternative A would be the same as for Alternative B.

Lucky Peak Reservoir

Alternative B effects on vegetation and wildlife would be the same as for No Action but would be shorter in duration and would be a single event. Wildlife which forage for fish at Lucky Peak Lake may find it more difficult to locate and capture prey due to high turbidity.

Lower Boise River

The effect of Alternative B in Construction Season 3 would be generally the same as No Action maintenance years, but would be for a shorter period (9 weeks compared to 5 months) and would be a single event. Alternative B effects would be greater than Alternative A, but would still be limited to reduced foraging capability of wildlife that seek aquatic prey.

Anderson Ranch Reservoir and South Fork Boise River

Alternative B would have no measurable effect on vegetation or wildlife at Anderson Ranch Reservoir and along the South Fork Boise River, although Anderson Ranch pool could be expected to be somewhat smaller by the beginning of Construction Season 3 compared to No Action and Alternative A.

Mitigation and Residual Effects

Areas disturbed and cleared for construction staging and disposal of concrete waste would be reseeded as for Alternative A. Replacement of the minor and short term loss of open water habitat would not be practical, and no mitigation was identified or proposed. All of the wildlife effects would be residual effects.

Threatened and Endangered Species

Affected Environment

Reclamation requested a listing of ESA listed threatened and endangered species and species proposed as threatened or endangered that could potentially be present in the area or potentially affected by the proposed rehabilitation of the outlet works at Arrowrock Dam. The USFWS identified the following species: bull trout (threatened), bald eagle (threatened), Ute Ladies'-tresses (threatened) and gray wolf (endangered). NMFS referred Reclamation to the following listed anadromous fish species for consideration under Section 7 of ESA: Snake River sockeye (endangered), Upper Columbia River Spring chinook (endangered), Upper Columbia River steelhead (endangered), Snake River spring/summer chinook (threatened), Snake River fall chinook (threatened), Snake River steelhead (threatened), Lower Columbia River steelhead (threatened), Middle Columbia River steelhead (threatened), and Columbia River chum salmon (threatened).

In compliance with Section 7 of ESA, Reclamation submitted a draft BA to USFWS describing impacts of the proposed action on listed species (Reclamation, 1999). More detailed information on bull trout and bald eagle life history, recovery efforts, habitat requirements, and factors contributing to the species decline is included in the BA.

Reclamation received a Draft BO from USFWS in January 2001. The Draft BO concurred with Reclamation determinations on impacts to listed species and provides RPM's and Terms and Conditions to minimize take of bull trout and bald eagles. A summary of the RPM's and Terms and Conditions is included in Appendix C. Reclamation provided USFWS with comments on the Draft BO and expects to receive the Final BO in March 2001.

Bull Trout

Life History and Habitat

Bull trout (*Salvelinus confluentus*) is a char native to the Pacific Northwest and western Canada. This species was listed as a threatened species under ESA in June of 1998. Despite relatively broad distribution, bull trout are believed to be in widespread decline. Batt (1996) states that bull trout are the least studied salmonid in Idaho. Until recently, there had been little data on the presence of the species in the known or suspected range in southern Idaho; ongoing research is beginning to fill data gaps. USFWS is currently leading a multi-agency effort to prepare a recovery plan for bull trout.

Bull trout appear to have more specific habitat requirements and are probably more sensitive to habitat changes than other salmonids (Rieman and McIntyre, 1993). Channel stability, winter high flows, summer low flows, substrate, cover, temperature, and the presence of migration corridors consistently appear to influence bull trout distribution. Bull trout are generally restricted to colder stream temperatures than other salmonids. Threats to bull trout include

stream channel and water quality degradation from land use practices, blockage of migration corridors by dams, and the introduction of non-native species such as brook trout.

In the Snake River basin, bull trout exhibit two distinct life history forms– migrant and resident. Migrant fish emigrate from the small streams, where the juveniles rear, to larger rivers (**fluvial** fish) or to lakes and reservoirs (adfluvial fish). Resident fish remain in the rearing streams. Growth differs little between migratory and resident forms during their first years of life in headwater streams, but diverges as migratory fish move into larger and more productive waters (Rieman and McIntyre, 1993). Resident and migratory forms may live together, but it is unknown if they represent a single population or separate populations. During their life cycle, migratory forms appear to range over much of the river basin available to them (see Bjornn et al. in Batt, 1996).

Bull trout can live up to 10 years and are sexually mature after 4 years. They spawn during September through November, in cold, flowing groundwater-fed streams that are clean and free of sediment. Bull trout may spawn each year or in alternate years (see Block et al. in Batt, 1996). It is possible that four or more **year classes** could compose any spawning population, with each year class including up to three life history forms (adfluvial, fluvial, and resident fish).

The incubation period for bull trout is extremely long, and young fry may take up to 225 days to emerge from the gravel. Migrant bull trout usually emigrate from their rearing streams at 2-3 years of age when they are 6-8 inches long; however, younger fish may occasionally outmigrate earlier (Elle et al., 1994). They move downstream to a river or lake and find feeding sites. After entering the river or lake, juvenile bull trout grow rapidly, often reaching 20 inches or longer and 2 pounds by the time they are 5-6 years old. The Idaho bull trout record is 32 pounds for a fish taken from Lake Pend Oreille in 1949.

Bull Trout Status in the Boise River

Bull trout are found in Anderson Ranch and Arrowrock Reservoirs, Lucky Peak Lake, and the Middle, North, and South Forks of the Boise River upstream from the reservoirs. IDFG (Batt, 1996) identified the Boise River upstream from Arrowrock Reservoir and the South Fork upstream and downstream from Anderson Ranch Reservoir as key watersheds for this species. USFS has monitored headwater streams in the Boise River for the presence of bull trout and found them quite common in some streams, but absent from many upper basin watersheds where they were historically found.

Bull trout inhabiting Arrowrock and Anderson Ranch Reservoirs are adfluvial forms which spend several years in the reservoirs until they mature, generally at 5-7 years old. In late spring, mature fish migrate upstream from the reservoirs; in the fall, they spawn in headwater streams. After spawning, the adults return to the reservoirs where they overwinter. Juvenile fish remain in the upper watersheds for up to 3 years before migrating to larger streams and reservoirs.

Arrowrock Reservoir constitutes an important over-wintering and foraging area for a relatively strong population of migratory bull trout. Sub-adults and adults migrate into Arrowrock from

upstream tributaries of the three forks of the Boise River. The reservoir serves as important bull trout habitat from November through the late spring and early summer. Many of these fish then migrate out of Arrowrock and into upstream riverine areas where they find cooler water temperatures and available spawning habitat. This migratory component is very important to the overall health and long term persistence and recovery of this fish species. Except for years when Arrowrock is drained because of drought conditions or for maintenance, fish habitat in Arrowrock is most likely available to bull trout and other aquatic species that reside there.

IDFG, with funding from Reclamation, conducted a radiotelemetry and mark and recapture study of bull trout at Arrowrock Reservoir from 1996-1998 (Flatter, 1999). The purpose of the study was to help assess the population and the life history. The major findings of this study are:

- Adult bull trout migrate from Arrowrock Reservoir into the Middle and North Forks of the Boise River from May to June and spawn in the upper tributaries in August and September. Not all adult fish migrate in a given year.

- Adfluvial mature bull trout appear to reside in Arrowrock Reservoir for about 6 months, from November to June. These fish most likely forage in shallow areas where the majority of prey exists. Depending on water conditions, bull trout will occupy deeper areas of the reservoir where water temperatures are cooler (45-54 °F) and move to the surface when surface water temperatures drop to or below 54 °F.

- A substantial number of adult fish were entrained into Lucky Peak Lake either over the spillway or through the Ensign valves. Although these fish may survive, they are lost to the spawning population since there are no suitable spawning tributaries to Lucky Peak Lake.

- An estimated 471 bull trout, 12 inches or longer, resided in Arrowrock Reservoir in 1997; mean length was 16 inches. The estimate for 1998 was 354 bull trout.

- Some bull trout captured in Lucky Peak and radio tagged were subsequently transported to Arrowrock Reservoir for release. Some of the released bull trout exhibited spawning behavior by moving to spawning locations in the upper Boise River.

Bull trout found in Lucky Peak Lake are a result of entrainment through Arrowrock Dam. After entering Lucky Peak Lake, bull trout are no longer part of the reproducing population as there are no suitable tributaries for them to migrate into for spawning. Flatter (1999) reported that 42 bull trout equal to or greater than 12 inches passed from Arrowrock into Lucky Peak in 1997 and estimated that 54 bull trout equal to or greater than 12 inches passed into Lucky Peak in 1998. Substantial numbers of adult Arrowrock bull trout appear to be lost each year during normal operations of Arrowrock Dam.

Beginning in 2000, Reclamation initiated the trapping and hauling of bull trout from Lucky Peak Lake to Arrowrock Reservoir as part of the USFWS Terms and Conditions identified in their BO for Reclamation Operations (USFWS, 1999). This trap and haul program will continue until a

permanent solution to bull trout entrainment is found. In the spring of 2000, twenty-five bull trout were trapped and transported for release in Arrowrock as part of this program.

Reclamation assisted IDFG in a radiotelemetry and mark and recapture study of bull trout at Anderson Ranch Reservoir in 1998-1999. The study found that Anderson Ranch bull trout exhibited similar migratory behavior to the Arrowrock bull trout, leaving the reservoir in late spring and spawning in the upper South Fork tributaries. The estimate of bull trout numbers in Anderson Ranch Reservoir for 1999-2000 is 370 individuals with a range in lengths of 8½ to 29 inches. One notable contrast between Arrowrock Dam and Anderson Ranch Dam, is that the Anderson Ranch study did not document entrainment of fish through Anderson Ranch Dam. The lack of entrainment at Anderson Ranch Dam may be due to releases from a greater depth and infrequent and later spills as compared to Arrowrock Dam operations.

Reclamation, in cooperation with USFS, is currently conducting research on bull trout in the North Fork Boise River. The study will examine the relationship of bull trout numbers to habitat conditions and will provide information on the North Fork migratory bull trout population, age, growth, and migration timing. Information will also be developed on juvenile bull trout that migrate into Arrowrock and reside in the reservoir year round until they are sexually mature.

USFWS Biological Opinion on Reclamation's Operation and Maintenance Activities

In April 1998, in compliance with ESA, Reclamation submitted a BA to USFWS and NMFS on operations and maintenance of Reclamation projects in the Snake River Basin above Lower Granite Reservoir (Reclamation, 1998). This document analyzed the effects on ESA listed species for normal operation and maintenance activities of Reclamation projects in the Snake River basin, including the Boise River basin. The BA did not specifically address drawdown of Arrowrock Reservoir for inspection and repair of the lower Ensign valves on Arrowrock Dam. However, the BA concluded that operation and maintenance activities at Arrowrock Dam adversely affect bull trout primarily through entrainment of fish through the dam and drawdown of the reservoir.

On October 15, 1999, USFWS provided a BO to Reclamation on this BA. USFWS concurred that operation and maintenance of Arrowrock Dam may adversely affect bull trout. USFWS also identified RPM's that Reclamation must follow to avoid the prohibitions of Section 9 of ESA. These terms and conditions are non-discretionary. USFWS believes the following RPM's are necessary and appropriate to minimize the take of bull trout:

- Reduce incidence of bull trout entrainment due to reservoir operations.

- Ensure reservoir operations do not result in de-watering of Reclamation reservoirs to the extent that adfluvial bull trout resident there during part of their life history are stressed or killed.

- Investigate methods to provide safe fish passage around Reclamation dams for bull trout.

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) is currently listed by USFWS as threatened in all lower 48 contiguous states. Reproduction in North America declined dramatically between 1947 and 1970 largely due to ingestion of organochloride pesticides (USFWS, 1986). However, the bald eagle population has clearly increased since that time and has expanded its range. Due to the overall population increase, the bald eagle was reclassified from endangered to threatened in all of the lower 48 states in 1995 (USFWS 1995). On July 6, 1999, USFWS published a *Proposed Rule to Remove the Bald Eagle in the Lower 48 States from the List of Endangered and Threatened Wildlife* (64 FR 36454). This proposed delisting is based on the fact that recovery goals for the bald eagle have generally been met range-wide.

The bald eagle is a member of the hawk family with a weight of 6½ to 14 pounds and a wing span of 6 to 7½ feet. Mature adults are easily recognized by the white head and tail; yellow eyes, bill, and feet; and large size. Like most birds of prey, bald eagles exhibits reverse sexual size dimorphism with the females larger than the males. Males and females are thought to mate for life and return to the same nesting territory year after year. A clutch of one to three eggs is laid and then incubated, primarily by the female, for about 35 days. The young fledge in 72-75 days. Bald eagles require 4-5 years to reach sexual maturity and attain full adult plumage. Prior to that time, immature bald eagles are often confused with immature golden eagles.

The nesting season for bald eagles in the Pacific Northwest generally extends from January 1 to mid-August (USFWS 1994). Young are usually produced in March and fledged in July; however, they may stay near the nest for several weeks after fledging. The diet of nesting bald eagles consists primarily of fish but bald eagles are opportunistic foragers and also consume waterfowl, rabbits, and mammalian **carrion** (USFWS 1994).

Bald eagles also winter in the Pacific Northwest from about November through March and are primarily associated with open water near concentrated food sources. Eagles begin arriving in late October with peak numbers in late January or early February. Wintering bald eagles are usually gone by the end of March.

The Pacific Bald Eagle Recovery Plan identifies two target recovery breeding territories for the Boise River/Anderson Ranch area in addition to one existing territory. Two active bald eagle nesting territories are located on Arrowrock Reservoir; one, discovered in 1995 near the confluence of the South Fork and Middle Fork reservoir arms about 4 miles upstream from Arrowrock Dam (Arrowrock nest) and a new nest discovered in 2000 located about a mile southeast of the dam where Grouse Creek enters the reservoir.

The Arrowrock nest has successfully fledged young each year from 1996 through 1998 (Beals and Melquist 1995, 1996, 1997, 1998). During the winter of 1998-1999, the nest tree for the Arrowrock pair blew down, and a new nest was built nearby in 1999, but fledging was not confirmed (Holderman, 2000). A nesting territory management plan has not been prepared for the Arrowrock nest, and except for yearly surveys for occupancy and productivity, no comprehensive information about this pair's habitat use such as home range, foraging habits, and

perch trees has been collected. USFS personnel have frequently observed this pair foraging along the South Fork Boise River upstream of Arrowrock Reservoir (Holderman, 1999). There is also an abundance of deer and elk wintering in the area, and the bald eagles from the Arrowrock nest probably rely on deer and elk carrion for food early in the nesting season (Holderman, 1999).

The new nest is located in a cottonwood tree in the bay where Grouse Creek enters the south side of the reservoir. Although the nest is only about a mile from Arrowrock Dam, it is visually screened by a ridge. In June 2000, three young were observed in the nest, but the nest was not monitored through the summer, and fledging was not documented (Holderman, 2000). Like the Arrowrock nest, there is little known about this nesting pair's habitat use, but because the nest is near Lucky Peak Lake, they may forage there as well as at Arrowrock Reservoir. They probably also rely on big game carrion early in the nesting season.

There are two bald eagle nesting territories on Anderson Ranch Reservoir and a third nesting territory further upstream near Featherville.

Lake Lowell, located within Deer Flat National Wildlife Refuge is an important area for bald eagles with abundant prey (fish and waterfowl), suitable nesting and perching trees, and relatively free of human disturbance much of the year. Bald eagles both nest and winter at Lake Lowell. One nesting territory has been documented since 1988 and has been successful in producing young in 1999 and 2000. Taylor and Bechard (1991) observed resident adult and newly fledged eagles at Lake Lowell in August feeding on fish, primarily carp, and waterfowl and predominantly using a mudflat area near the nest site.

The Boise River upstream from Lucky Peak Lake is considered an important wintering area for bald eagles. In their 2-year study of wintering bald eagles in the upper Boise River, Kaltenecker and Bechard (1995) found fairly heavy use at Anderson Ranch Reservoir (up to 50 eagles documented) and the South Fork Boise River below Anderson Ranch Dam (2-25 eagles). Arrowrock Reservoir and Lucky Peak Lake provide habitat for bald eagles in the winter, with as many as 15 counted by Kaltenecker and Bechard (1995).

Although Kaltenecker and Bechard found bald eagles everywhere at the reservoirs, there were distinct areas of concentration. The heaviest concentrations of eagles at Arrowrock Reservoir were at the upper reaches of the South Fork and Middle Fork arms and near the South Fork and Middle Fork confluence. At Lucky Peak Lake, winter use was heaviest along the rocky outcrop on the south side of the reservoir just downstream from Arrowrock Dam; eagles were observed fishing from the inlet stream released from Arrowrock Dam. Eagles were also frequently observed perched on the mudflats across from Spring Shores Marina. Later in the winter when deer carcasses were available, many eagles were observed at the Mores Creek arm.

The diet of wintering bald eagles consists primarily of fish early in the winter. As winter progresses, the diet shifts to big game carrion. This shift is likely due to reservoir and river icing making it difficult to capture fish and increased availability of deer and elk carcasses (Kaltenecker and Bechard 1995). Waterfowl are also taken as prey.

The Boise River downstream from Lucky Peak Dam is an important winter habitat for bald eagles with as many as 35 individuals counted in a single year (USFWS, 1996; Riggin and Hansen, 1992). Several studies of wintering bald eagles downstream from Lucky Peak Lake have been conducted, with most of the effort concentrated on the reach between Lucky Peak Dam and the city of Boise. These studies have shown that bald eagles usually arrive in early November and leave the area by late March with highest concentrations in January and February. Wintering eagles tend to perch throughout the area but prefer wide areas of the river and pools in well-vegetated areas with high numbers of perches. They seem to avoid areas of high human use. The Barber Pool area, immediately upstream from the city of Boise, has been documented as having special importance as a communal night roost.

The diet of bald eagles wintering along the lower Boise River includes fish, waterfowl and other birds, and mammals. Hatchery rainbow trout appear to be important, but other fish species are also taken.

As in other areas of the Boise Valley, wintering bald eagles begin arriving at Lake Lowell in late October and with numbers as high as 10 to 20 birds over the last 10 or so years. The number of birds using Lake Lowell in the winter largely depends on ice conditions at the reservoir. Wintering bald eagles have been observed perching in large open cottonwoods mudflats and the shoreline prior to ice formation. Taylor and Bechard (1991) found that once ice formed over most of the lake, eagle numbers decreased and eagles were concentrated near the only open water near the New York Canal inlet. Waterfowl was the primary prey item of wintering eagles with fish making up the remainder of the diet.

Gray Wolf

The gray wolf (*Canis lupus*), currently listed as endangered, was historically present in the Boise River basin but extirpated from the western states about 1930. An experimental population of gray wolves was introduced into Yellowstone National Park in 1995 and into central Idaho in 1996. Wolves are now reproducing in the uppermost reaches of the Snake River and in central Idaho, the upper Deadwood River drainage, and possibly the upper Boise River watershed in the Sawtooth Mountains. This population of wolves is classified "experimental, non-essential" by USFWS.

Gray wolves have been documented in the North and South Fork Boise River drainages, and there are unconfirmed reports of wolves in the Boise Front near Lucky Peak Lake and Arrowrock Reservoir. These animals may be individuals that have dispersed from other packs or may be individuals following the seasonal elk and deer migrations.

Ute Ladies'-Tresses

Ute ladies'-tresses (*Spiranthes diluvialis*), listed as threatened January 17, 1992, is a perennial, terrestrial orchid 8 to 20 inches tall with small white flowers arranged in a clustered spike. In Idaho it generally blooms from early August through mid September. Ute ladies'-tresses has the

potential to occur in wetland and riparian areas including springs, wet meadows and river meanders at elevations ranging from 1,500 to 7,000 feet (USFWS 1998).

Ute ladies'-tresses have been found in Idaho, Utah, Colorado, Montana, Nebraska, Wyoming, and Washington. It has only been recorded in Idaho along the South Fork of the Snake River in the eastern part of the state. Recent records of the species in northern Washington, which is considerably farther north and west of previously known occurrences have led to the belief by USFWS that it could be present in suitable habitat in other parts of Idaho. Given the distribution and variety of habitats in which Ute ladies'-tresses are found, it is not possible to narrowly define potential habitat for this species. USFWS experience indicates that although potential habitat is fairly widespread, actual occurrences of Ute ladies'-tresses are rare.

Snake River Salmon and Steelhead

NMFS determined that no ESA listed Snake River salmon or steelhead are in the project area or immediately downstream from it. The final critical habitat designated for listed Snake River salmon (December 28, 1993, 58 FR 68453) does not include the proposed project areas. However, NMFS, indicated that the operation of Reclamation projects on the Boise River may affect ESA listed salmon and steelhead, spawning, rearing, and migrating in the Snake River downstream of Hells Canyon Dam.

NMFS referred Reclamation to the following listed anadromous fish species for consideration under Section 7 of ESA: Snake River sockeye (endangered), Upper Columbia River Spring chinook (endangered), Upper Columbia River steelhead (endangered), Snake River spring/summer chinook (threatened), Snake River fall chinook (threatened), Snake River steelhead (threatened), Lower Columbia River steelhead (threatened), Middle Columbia River steelhead (threatened), and Columbia River chum salmon (threatened).

NMFS BO directed Reclamation to manage and release an amount of reservoir storage in the upper Snake and Columbia River basins for flow augmentation during salmon and steelhead juvenile migration to the ocean. In the case of upper Snake, Reclamation annually secures delivery of 427,000 acre-feet to increase main stem Snake and Columbia flows during the summer months. These reservoir drafts are intended to improve main stem Columbia River fish migration conditions.

Environmental Consequences

Bull Trout

There would be no impacts to bull trout in Anderson Ranch Reservoir and the existing distribution of bull trout does not extend downstream of Lucky Peak Dam. As a result, this discussion of impacts is limited to Arrowrock Reservoir, Lucky Peak Lake, and the South Fork Boise River downstream of Anderson Ranch Dam.

Impact Indicators/Methods of Evaluation

Impact indicators and methods of evaluation are the same as described for fish resources. The primary factors that impact bull trout include the following:

- Water flows, depths, and fluctuations
- Water temperature
- Oxygen content and TDG
- Nutrient content and turbidity
- Entrainment

Turbidity and suspended sediment are considered to be the significant short term impact indicator for bull trout. The effects of suspended sediment on fish will vary with life stage, species, concentration of suspended sediments, duration of exposure, and suspended sediment particle size and shape. Early life history stages are most sensitive. Adult fish can withstand higher TSS concentrations and longer durations of exposure. Despite evidence of adverse effects from high concentrations of suspended sediment, bull trout migrate up the Boise River during turbid spring runoff conditions.

Specific TSS concentrations in reservoirs and river reaches cannot be predicted because of several unknown variables that influence sediment transport. However, predictions for broad ranges of TSS concentrations have been made based on data from Black Canyon and American Falls Reservoirs (see appendix C), TSS predictions from similar reservoir drawdown analysis (Elwah River Ecosystem Restoration Implementation DEIS), and observations and video of the last maintenance drawdown of Arrowrock Reservoir in 1987 and in other low water levels during drought years.

No Action Alternative

The No Action Alternative would impact bull trout in every maintenance drawdown year.

Arrowrock Reservoir

Migratory bull trout return to Arrowrock Reservoir beginning around mid-October and continuing through mid-December and overwinter in the reservoir. During a maintenance draw down, most bull trout in the reservoir will either continue through the sluice gates into Lucky Peak Lake or move back upstream into the Middle Fork (and possibly the South Fork) of the Boise River seeking improved habitat conditions. Some bull trout could become stranded as Arrowrock Reservoir is drawn down to the maintenance level. It is expected that nearly 100 percent of the Arrowrock bull trout population would pass into Lucky Peak Lake.

The impacts of the No Action Alternative on bull trout would be much like the impacts to other fish. TSS levels of 1,000-10,000 mg/L could occur for more than 4 days which would be lethal to most fish species. TSS concentrations should be highest during the final stages of drawdown

and subside to less than 1000 mg/L after the majority of sediment has been flushed from Arrowrock.

Under the No Action Alternative, the prey base for bull trout in Arrowrock Reservoir would be eliminated during the maintenance drawdown. Recovery of the reservoir trout fishery with normal stocking rates by the IDFG would take 2 to 3 years. Other fish populations would take 1-4 years to recover (Olympic National Park, 1996).

These impacts to bull trout would be chronic and would occur every sixth year under No Action.

Lucky Peak Lake

Impacts to bull trout would be the same as described for fish in general. TSS concentrations in Lucky Peak Lake near Arrowrock Dam will be highest during the final stages of drafting Arrowrock Reservoir. Conditions near Arrowrock Dam would most likely exceed 10,000 mg/L for more than 4 days and could result in fish mortality. Turbidity impact may be somewhat more acute for bull trout as they are primarily a fish eating species and prey would be more difficult to find under turbid conditions. Increases in suspended sediments could kill large numbers of fish and aquatic life in Lucky Peak Lake in the short term. The finer-grained sediments, such as silt and clay, at very high concentrations could affect fish by smothering adults. The prey base (fish, crayfish, and benthic invertebrates) could suffer high mortality.

TSS levels throughout the remainder of Lucky Peak Lake should be less than 1,000 mg/L and not result in fish mortality. After the majority of fine sediments has been flushed from Arrowrock Reservoir (about 1-2 weeks), TSS concentrations in Lucky Peak Lake should remain at non-lethal levels. Maintenance of Lucky Peak Lake at elevation 2957 feet should lessen the impact of large amounts of sediment flushed into the reservoir. Bull trout would also have the opportunity to move to some areas of Lucky Peak Lake which may provide a more suitable environment with little to no water quality impacts as compared to the main body of Lucky Peak Lake.

It is anticipated that few bull trout would be entrained through Lucky Peak Dam and lost to the lower Boise River.

South Fork Boise River

The No Action Alternative would not likely have any adverse impacts to bull trout in the South Fork Boise River other than as described for the migratory forms that enter Arrowrock Reservoir.

Mitigation and Residual Effects

Since adverse effect to bull trout would occur under No Action, Reclamation would be required to formally consult with USFWS on the intensive maintenance program. USFWS would issue a BO with measures to minimize impacts to bull trout. Measures that have been discussed with USFS for the action alternatives include (1) a fish weir and trap on the Middle Fork Boise River located upstream from Arrowrock Reservoir where, depending on water quality conditions in

Arrowrock Reservoir, bull trout may be trapped and transported to Lucky Peak Lake; (2) the trapping and transporting of bull trout from Lucky Peak Lake to Arrowrock Reservoir when Arrowrock Reservoir is being filled following construction; and (3) the monitoring of bull trout throughout the maintenance period.

Residual effects will be the numbers of bull trout lost from the adult upstream population. This would include bull trout that die or are not successfully transported from Lucky Peak Lake, and any lost to the lower Boise River. Since trap and haul efforts would take about 2-3 years and recovery of the adult population would take 8-10 years, the Arrowrock Reservoir bull trout population would not recover before the next maintenance drawdown. Over the long-term, the bull trout population would continue to decrease.

Alternative A (Preferred Alternative)

There would be no impacts to bull trout through the first two construction seasons. As a result the discussion is limited to impacts of the third construction season.

Arrowrock Reservoir

Bull trout in Arrowrock Reservoir would be potentially impacted by entrainment into Lucky Peak and by elevated TSS levels and turbidity as Arrowrock Reservoir is being drafted during the third construction season. To minimize the impacts to migratory bull trout returning to Arrowrock Reservoir, the migrants would be trapped in the Middle Fork Boise River upstream of Arrowrock Reservoir and transported to Lucky Peak Lake. (See Alternative A, Mitigation discussion.) It is anticipated that nearly all adults that return from spawning and a significant percentage of juveniles entering Arrowrock Reservoir for the first time could be trapped and transported.

Entrainment of bull trout would likely be proportional to the volume of water discharged (Appendix I). Nearly all bull trout remaining in the residual pool would be entrained through Arrowrock Dam. These individual would consist of adults that did not migrate and those that migrated up the South Fork or escaped the Middle Fork weir trap and juvenile fish remaining in the pool or not trapped. Based on Flatter (1998, 1999) an estimated twelve percent of the adult population was non-migratory in a given year, and radio-tagged fish that moved up the South Fork Boise River comprised 5 and 8 percent of those fish monitored in 1997 and 1998, respectively.

The population of juvenile fish that may be present is unknown at this time. Flatter (1998, 1999) was unable to estimate juvenile populations due to insufficient sample size. Studies are currently underway to determine juvenile riverine migration patterns. Juvenile tracking work is anticipated to be concluded prior to the initiation of the drawdown for Alternative A. This tracking work will enhance the explanation of the effects of Alternative A on the juvenile component and assist in developing additional mitigation.

Entrained fish would be subject to conditions described under the Fish section above. Although there has been no documentation of mortality or noticeable injury to bull trout captured in Lucky Peak, physical harm to the fish incurred during entrainment is possible.

Turbidity in the Arrowrock pool during and following drawdown to 3027 feet would increase due to sloughing of the unstable banks and redistribution of bottom sediments. After an undetermined period, inflow to the residual pool would clear with most turbidity limited to where the river enters the residual pool. Increases in turbidity, which will be highly dependent on the inflow to Arrowrock, could result in mortality to the few bull trout that remain in the residual pool. During similar drawdown events in the drought years of 1989 and 1991, no fish kills were reported. Maintenance of a residual pool is predicted to greatly reduce turbidity compared to the extremely turbid conditions that would occur under the No Action Alternative.

Bottom-dwelling, nonmigratory prey of bull trout, such as sucker and chiselmouth, may tend to remain in the residual pool and would be subject to conditions in the pool as described above. However, these species are omnivorous bottom feeders and may be able to endure higher levels of turbidity. Effects of increased levels of turbidity on these species may be lessened due to the fact that under normal conditions these fishes occupy the benthos, which when the reservoir is stratified, contains lower levels of oxygen and higher turbidity. Native salmonid prey species, such as whitefish, will be moving out of the reservoir during the drawdown period to spawn in late October and November (Salow, unpublished data). These fish will be captured in the Middle Fork weir trap and moved around the trap to continue their movement upstream.

Stocking of other salmonid species will be altered to reduce loss of hatchery fish and increase the game fish component of the reservoir in the years following the project. Recovery of prey base would be expected to take 2-3 years.

The long-term impacts of Alternative A on bull trout would be beneficial compared to historical operation and the No Action Alternative. With the new clamshell gates which can operate at a much greater hydraulic head than the Ensign valves, fewer bull trout would likely be entrained through the dam. Flatter (1999), in bull trout studies at Arrowrock Dam, concluded that bull trout entrainment through the upper row of Ensign valves in 1998 was near 6 percent (22 adult bull trout). In contrast, radio telemetry studies (IDFG, 2000b) at Anderson Ranch Reservoir, where water releases are made much deeper, have shown that no radio tagged bull trout were entrained through Anderson Ranch Dam.

Flatter (1999) also found that bull trout entrainment occurs over the spillway at Arrowrock Dam. Alternative A would have no effect on this type of entrainment.

Lucky Peak Lake

In Construction Season 3, Lucky Peak Lake would be maintained at or above 2957 to the extent possible as described for the No Action Alternative. If the sluice gates are not used, there would be little or no impact on bull trout in Lucky Peak. If the sluice gates are used for more than 3 consecutive days, bull trout would be impacted but suitable habitat with adequate water quality

would likely be available in Lucky Peak. There is a 85 percent chance that the Arrowrock sluice gates would not be opened.

South Fork Boise River

Alternative A would have no impact on bull trout in the South Fork Boise River.

Mitigation and Residual Effects

The decision to allow the upstream work area to flood for up to 5 days of flooding in Construction Season 3 would reduce the probability of sluice gate use and associated water quality impacts to fish in Arrowrock Reservoir, Lucky Peak Lake, and the lower Boise River. The probability of having to use sluice gates would drop from 42 percent to 15 percent.

Reclamation has consulted with USFWS under Section 7 of ESA and received a Draft BO for the project. Reclamation proposes a mitigation strategy for bull trout consistent with the recommendations in Draft BO and the USFWS Final FWCA Report (Appendix F). A detailed explanation of the bull trout mitigation measures is found in Appendix I. Major bull trout mitigation elements include:

- Trapping bull trout upstream of Arrowrock Dam in year 3 using a weir on the Middle Fork Boise River and transporting to Lucky Peak Lake
- Recapture of bull trout in Lucky Peak Lake and returning them to Arrowrock Reservoir after completion of the project
- Arrowrock Reservoir population surveys prior to and after construction
- Radiotelemetry monitoring of bull trout during and after the project
- Formation of an interagency Arrowrock Valve Replacement Working Group to guide monitoring, mitigation and recommend operational changes during the project
- Commitment to meet the measures specified in the USFWS 1999 BO on Reclamation operations, especially reducing bull trout entrainment and determination and implementation of a minimum pool in Arrowrock

The restocking of Arrowrock Reservoir with rainbow trout and kokanee after construction would augment the depleted prey base in Arrowrock Reservoir.

Even with these mitigation measures, some bull trout would be either killed or stressed from the project. Residual effects to the bull trout population could persist for 8-10 years

Alternative B

Alternative B, like Alternative A, would not impact bull trout through the first two construction seasons. As a result the discussion for Alternative B is limited to impacts of the third construction season.

Arrowrock Reservoir

While most bull trout would pass unharmed into Lucky Peak Lake during drawdown, those that remain in the residual pool would most likely move upstream and hold in the Boise River where acceptable water quality conditions would prevail. Some bull trout could become stranded as Arrowrock Reservoir is drawn down to the maintenance level. Bull trout that remain in the residual pool for an extended period would likely die.

Alternative B impacts are similar but much less extensive than a No Action maintenance drawdown due to the short duration and timing. Under Alternative B, the Arrowrock pool would already have been drawn down to elevation 3007 feet for 1½ months before all of the migrating bull trout begin to return. The pool would begin filling nearly a month before all of the migrating bull trout return. Arrowrock Reservoir would be at 3007 feet for only 3 weeks of the normal 2-month period during which bull trout return to Arrowrock to overwinter. Late returning bull trout would experience better water quality conditions, but a limited food supply. This effect would be temporary and the prey base would recover more rapidly than under No Action.

The potential for mortality and entrainment of bull trout under Alternative B would be less than under No Action but greater than under Alternative A.

Long-term effects attributable to Alternative B would be the same as the long-term effects of Alternative A, i.e., beneficial compared to historical operations and the No Action Alternative.

Lucky Peak Lake

Alternative B adverse impacts to bull trout would be similar to No Action, but would be for a shorter duration and would be a one time event. The impact under Alternative B would be greater than for Alternative A.

South Fork Boise River

Although flows would be higher in Construction Season 3 with Alternative B, the impacts to bull trout would be the same as for Alternative A with no adverse impact to bull trout.

Mitigation and Residual Effects

Mitigation for Alternative B would be the same as for Alternative A, but temporary residual effects would be more and adverse.

Bald Eagle

Nesting bald eagles at Anderson Ranch Reservoir and wintering bald eagles at Anderson Ranch Reservoir and along the South Fork Boise River upstream of Arrowrock Reservoir would not be affected by the No Action or action alternatives.

The discussion in this section is limited to Arrowrock Reservoir and downstream reaches.

Impact Indicators/Methods of Evaluation

Environmental factors critical to bald eagles are relatively undisturbed areas for nesting and perching sites and available food supply. The food supply consists mainly of fish but also includes waterfowl and mammalian carrion, important food sources in the winter.

No Action

Environmental Consequences

The nesting pairs of bald eagles at Arrowrock Reservoir may be adversely affected by food supply reduction in Arrowrock Reservoir in maintenance drawdown years. During these drawdowns, fish would likely move into Lucky Peak Lake or possibly move upstream into the Middle and South Forks of the Boise River upstream of Arrowrock Reservoir. Those that remain in the small pool behind Arrowrock Dam may perish. Since the nesting pair appears to spend a significant amount of time foraging in the South Fork Boise River, the importance of the effects on the Arrowrock fishery may not be critical to nesting success. Food resources of the Arrowrock nesting pair would also be reduced in years immediately following maintenance drawdowns as the reservoir fishery would be generally destroyed in the year of drawdown and suffer in subsequent years. Any difficulty in locating prey could reduce nest productivity of the Arrowrock eagle pair.

There would not likely be any disturbance to the Arrowrock or Grouse Creek nests during major maintenance. The Arrowrock nest is approximately 3.5 air miles from Arrowrock Dam on the opposite side of the reservoir from the road and with topographic features that effectively block the line of sight from the dam to the nest. The Grouse Creek nest is approximately a mile from the dam, but it too is on the opposite side of the reservoir from the road and visually screened by a ridge. Maintenance activities would be nearly finished for the season by the time the bald eagles arrive on the breeding territory.

The No Action Alternative may benefit wintering bald eagles in some years at certain locations along the Boise River and may limit the ability to find prey at times in other areas. During drawdowns, fish that hold in the shallow braided river in the upper end of the reservoir would be vulnerable to capture by bald eagles. This was observed by Kaltenecker and Bechard (1995) during extreme reservoir drawdown during drought years. Wintering bald eagles would also be able to use fish killed due to poor water quality in the small, turbid Arrowrock pool. Conversely,

in the following year or two immediately after drawdowns, the fish population in Arrowrock would likely be depressed, and winter foraging may be difficult there.

Entrainment of fish from Arrowrock into Lucky Peak Lake may increase prey available for bald eagles; however, turbid conditions in much of the reservoir may limit the ability of eagles to locate fish. The same may be true to some extent for those wintering eagles using the lower Boise River which would be turbid from October through February. Wintering eagles would likely tolerate human activity at the dam and would not be disturbed during maintenance work.

The No Action Alternative would have no effect on the availability of big game carrion.

During maintenance periods, water diverted to Lake Lowell would have high levels of suspended sediment and would increase turbidity at Lake Lowell. This could hinder the ability of bald eagles to capture fish at Lake Lowell from October through February. Since waterfowl are probably the primary prey species during this period and waterfowl numbers are not likely to be affected, adequate bald eagle prey should be available especially for nesting eagles, which probably arrive on the breeding territory in January or February and begin incubating in March based on Taylor and Bechard's (1991) observations. The No Action Alternative may affect but is not likely to adversely affect bald eagles at lake Lowell.

Mitigation and Residual Effects

No specific mitigation measures have been identified at this time for the No Action Alternative; however, Reclamation would be required to consult with USFWS, prior to undertaking the maintenance activities proposed in No Action. Through this consultation, USFWS may require certain terms and conditions to reduce bald eagle "take" as well and certain conservation recommendation to benefit the species.

It is likely that some augmentation of fish stocking would be requested to accelerated the recovery of the sport fishery in Arrowrock Reservoir immediately after maintenance drawdowns. Although that measure may lessen the drawdown effects to the bald eagle prey base, a period of 1-4 years would be needed for the full recovery of the prey base. As a result there would be some chance that the Arrowrock nesting pair would be less productive (fledging young) after each maintenance drawdown.

Alternative A (Preferred Alternative)

Environmental Consequences

Nesting and wintering bald eagles at Arrowrock Reservoir would not be affected through the first two construction seasons. The prey base would not change since there would be no reservoir drawdown. As in maintenance years under No Action, construction activities in all three years would be unlikely to disturb either of the bald eagle nests.

During Construction Season 3, it is likely that many fish would be entrained through Arrowrock Dam into Lucky Peak Lake or would move into the South Fork. However the 1,500-acre-foot pool would likely support some fish. Reservoir refill from elevation 3027 would begin about the time early nesting activity begins. Fish remaining in the upper riverine area of Arrowrock Reservoir would likely be more vulnerable to predation by bald eagles during the early nesting season in Construction Season 3 owing to the drawdown. Alternative A would have no effect on fish availability in South Fork Boise River and big game carrion that eagles may rely on early in the nesting season.

After construction, the scarcity of fish in a full Arrowrock Reservoir may require the Arrowrock nesting eagles and their young to rely more on the South Fork or even Lucky Peak Lake for foraging. Adverse impacts to the Arrowrock nesting pair of bald eagles would be short-term and minor compared to the periodic maintenance drawdowns under No Action.

Alternative A would be unlikely to adversely affect wintering bald eagles. The low Arrowrock pool in Construction Season 3 would make foraging easier in the upper reservoir during construction, but possibly more difficult in the year or two following until the fish population rebuilds. Wintering eagles, however, could disperse to other areas along the Boise River. Turbidity in the Arrowrock pool, Lucky Peak Lake, and possibly the lower Boise River may at times hamper foraging success. Any turbidity due to Alternative A in these waters would be small and of short duration compared to No Action.

Under Alternative A if the sluice gates are not needed to pass high winter flows, no increase in suspended sediment would be observed in the river reach below Lucky Peak Dam and there would be no effect to Lake Lowell water quality. If sluice gates are needed, it would probably be for a few days only, would cause only minor short term increases in suspended sediment in New York Canal diversions, and would be barely noticeable in Lake Lowell or the lower Boise River. Alternative A would have no effect on nesting and wintering bald eagles at Lake Lowell since their ability to locate and capture prey would not be impacted.

Over the long term, the new clamshell gates to be installed under Alternative A would allow for inspection and maintenance of these gates at any pool level of Arrowrock Reservoir, eliminating the current need for drawdowns below the level of the lower Ensign valves every 6 years. This would allow Reclamation to meet the minimum conservation pool goal of elevation 3078 feet or higher every year storage is available. It would also help to ensure that the eventual minimum pool required for bull trout by USFWS BO on operations (USFWS, 1998), is maintained in all years. The maintenance of the minimum pool would further ensure adequate forage for nesting and wintering bald eagles. In the long term, Alternative A would have a beneficial effect to both nesting and wintering bald eagles.

Mitigation and Residual Effects

USFWS, in their Draft BO (Appendix F), concurred with Reclamation's determination that Alternative A may adversely affect nesting bald eagles at Arrowrock Reservoir. Reclamation has proposed bald eagle mitigation that is consistent with the draft BO and Final FWCA Report for this project (Appendix F). Proposed mitigation measures include:

- Working with the USFS to develop nest site management plans for the two bald eagle nests at Arrowrock Reservoir

- Determining, in cooperation with USFWS, USFS and IDFG, the potential need and effectiveness of supplemental winter feeding of bald eagles at Arrowrock Reservoir during construction, and providing it, if needed

The re-stocking of fish by IDFG would augment the depleted bald eagle prey (fish) in Arrowrock Reservoir that are lost to entrainment.

Residual impacts related to reduced nest productivity may remain for a short period after implementation of mitigation measures.

Alternative B

Environmental Consequences

Alternative B impacts to bald eagles through the first two construction seasons would be the same as for Alternative A, i.e., no effect. Impacts to the availability of carrion in the winter through the entire construction period would also be the same as Alternative A, i.e., no effect. Construction would not disturb either nesting or wintering bald eagles.

During Construction Season 3, drawdown of Arrowrock Reservoir would eliminate the prey base of the reservoir for the drawdown period. Fish would move upstream, be stranded, perish in the small pool remaining, or, for the most part, be entrained into Lucky Peak Lake, similar to what would happen in a No Action maintenance year. A reduction in nest pair productivity may occur for 1-4 years after construction due to reduced prey base. Alternative B effects would occur only once compared to periodic drawdowns under No Action. Alternative B effects would be greater than those for Alternative A as the pool would be smaller under Alternative B, with a greater loss of reservoir fish.

Alternative B impacts to wintering bald eagles in Construction Season 3 would be less than that of a No Action drawdown because the Alternative B drawdown would be only 9 weeks compared to 5 months. Turbid conditions in Lucky Peak Lake and the lower Boise River would diminish in November, about the time wintering bald eagles arrive, allowing eagles to forage normally.

Alternative B long-term benefits to the bald eagle prey base in Arrowrock Reservoir would be identical to those of Alternative A.

Alternative B would have no effect on bald eagles at Lake Lowell since construction activities would end prior to diversions to fill Lake Lowell begin and there would be no water quality effects to the lake.

Mitigation and Residual Effects

Reclamation would consult with the USFWS under Section 7 of ESA (the same as for Alternative A). Reclamation would be required to implement measures identified in the BO that would reduce "incidental take" of bald eagles associated with the alternative. Furthermore, USFWS may also recommend and Reclamation may implement conservation measures for bald eagles.

Fishery mitigation for loss of prey base (fish) would likely be the same as for Alternative A but has not been specifically identified.

Residual impacts related to reduced nest productivity may remain even with implementation of mitigation measures.

Gray Wolf

None of the alternatives would have an impact on gray wolves. Any gray wolves in the vicinity of the Boise River reservoirs would likely be following prey species, probably wintering deer or elk. Neither of these species nor any other aspect of wolf habitat would be affected.

Ute Ladies'-Tresses

The likelihood of Ute ladies'-tresses occurring near Arrowrock Reservoir and downstream is small, given the lack of wet meadow, springs, and river meanders. The normal hydrologic alterations in the reservoir system, especially deep drawdowns during the growing season are unlikely to support this species. The even deeper drawdown and flow alterations proposed for either alternative would be unlikely to affect this species if it does occur in the area.

Snake River Salmon and Steelhead

Flow augmentation water from the upper Snake River basin to improve conditions in the lower Snake and Columbia Rivers for threatened and endangered salmon and steelhead will continue to be provided as discussed in the hydrology section. The proposed Valve Rehabilitation Project at Arrowrock Dam would have no affect on the ability of Reclamation to deliver flow augmentation water from the upper Snake River basin. The proposed action would also have no effect on listed Columbia River species.

Recreation

Affected Environment

Completion of Arrowrock Dam in 1915 dramatically changed the landscape and was the first major on-stream reservoir of the Boise Project. The subsequent construction of Anderson Ranch (1950) and Lucky Peak Dam (1957) provided flat-water recreational opportunities in the vicinity of the Boise metropolitan area. The proximity of reservoir and river recreation opportunities to the Boise metropolitan area is touted as one of the primary 'quality of life' factors attracting new residents to this area. The Boise River Greenbelt is a tremendous asset within Ada County and, along with the adjoining parks, is a continuing source of community pride.

The recreating public in the Boise metropolitan area has come to expect access to the reservoirs for boating, fishing, hunting, and camping. River operations for flood control and irrigation water supply directly influence the availability and quality of recreational opportunities. Currently, water based recreation in the Snake River basin, which includes the Boise River system, contributes more than $180 million per year to the State economy (Reclamation, 1999).

The Boise River system provides accessible, varied recreational opportunities to the largest population center in Idaho. Recreational opportunities are available in urban, rural, and wild settings all within a short distance from the city center. Water based recreation settings include the flat water of reservoirs and flowing waters of the rivers. Recreational fishing and boating are the prime attraction on flat and moving water. On some river reaches and at some water levels, white water boating is the main activity, but in other reaches and at lower water levels, floating on inner tubes and paddling canoes are popular activities. Camping, hiking, hunting and other land based recreation occur along the reservoirs and rivers.

Lands surrounding Anderson Ranch Reservoir and Arrowrock Reservoir are managed as part of the Boise National Forest. Land ownership and management responsibility is more complex around Lucky Peak Lake; major recreation providers are the Idaho Department of Parks and Recreation (IDPR) and the Corps.

The Boise River downstream from Lucky Peak Dam is bordered by some public land, including city, county, and state parks, but most of the land is in private ownership. IDPR manages land on Eagle Island at Eagle Island State Park. Ada County operates Barber Park downstream from Barber Dam and several city of Boise parks flank the river. The Boise River Greenbelt runs adjacent to the river on both banks through much of the city of Boise, Garden City, and beyond. The Greenbelt extends from Discovery Park just downstream of Lucky Peak Dam to beyond Glenwood Bridge. There are plans to continue the Greenbelt to the city of Eagle and into Canyon County. The cities of Eagle and Caldwell have a portion of Greenbelt along the river. Downstream of Caldwell to the confluence with the Snake River, there is little public access to the Boise River.

Specific information including site description, facilities and fees, recreations activities, and recreation use is included in each reach and reservoir section.

Arrowrock Reservoir

Arrowrock Dam is 17 river miles upstream from the city of Boise. This 18-mile-long narrow canyon reservoir has a full pool surface area of 3,150-acres and 60 miles of shoreline. A dusty, rough, narrow, gravel road winds along the north shoreline for much of the length of the reservoir to provide limited access to the shoreline. There are steep hillsides rising on both sides of the reservoir. Consequently, few recreation sites have been developed. The reservoir's remote setting provides an uncongested recreation experience.

Under an agreement between Reclamation and the Corps, stored water at Arrowrock is used to maintain a high recreation pool elevation at Lucky Peak Lake within the limits of water supply and irrigation demand (Shalkey Walker and Associates Inc., 1995). Low pool elevations at Arrowrock are common in the late summer and fall. Full pool elevation is 3216 feet.

Facilities

Arrowrock Reservoir provides limited boating, fishing, camping, and day use facilities (see table 3-11). During drawdown, dispersed camping takes place along the reservoir at the most level locations below the high water line. The low ramp is usable later in the season than the high ramp but both ramps usually become unusable by July or mid-August. Both ramps are located approximately 1 mile upstream from Arrowrock Dam.

Table 3-11. Arrowrock Reservoir Recreation Facilities[1]

Facility	Comments
Cinch Creek High boat ramp	3118.0 feet (lower end of ramp)
Cinch Creek Low boat ramp	3098.0 feet (lower end of ramp)
Cottonwood Campground	3-unit campground with rest room

[1] All facilities are managed by USFS, Mountain Home Ranger District (Reclamation, 2000a); full pool elevation is 3216 feet.

No fees are charged for recreation use at Arrowrock Reservoir.

Recreation Activities

Primary recreation activities at Arrowrock Reservoir include motorized boating, canoeing, windsurfing, personal water craft use, and fishing in the summer, followed by hunting, fishing and wildlife viewing in the fall and winter. Fishing season is open year-round.

Arrowrock Reservoir provides a mixed fishery supported by cold and cool water fish species. Fish species include rainbow trout, kokanee, yellow perch, whitefish, and the protected bull trout. During 1996 to 1998, the IDFG stocked the reservoir with an average of 8,000 fall chinook salmon fingerlings; 15,000 catchable size Kamloops/Steelhead hybrids, and 120,000 rainbow

trout fingerlings. IDFG manages Arrowrock Reservoir as a general fishery for rainbow trout and as a conservation fishery for bull trout; harvest of bull trout is prohibited (IDFG, 1998)

Upland bird hunters look for chukar, gray partridge, and California quail on the dry slopes above the reservoir. Big game hunters park along the road to access the slopes above the reservoir during deer and elk season (Beck and Baird, 1993). A small number of hunters boat across the reservoir to hunt.

Recreation Use and Season of Use

In general, Arrowrock Reservoir is used by recreationists in the spring, summer, and fall. Severe weather conditions and hazardous roads minimize winter use. According to USFS, the high use period at Arrowrock Reservoir is May through August. Fishing, a primary activity, is open year-round and peaks in June, July and August.

The summer recreation season is typically Memorial Day to Labor Day. Winter (October 1 to March 1) opportunities for recreation are few except for hunting, wildlife viewing and some fishing.

There are no recreation use figures by month or activity.

Most recreation use stems from the Boise metropolitan area. Arrowrock Reservoir receives the least recreational use of the three Boise River reservoirs (Beck and Baird, 1993). Visits to Arrowrock Reservoir from 1991 inventories totaled 15,000 for the year (Shalkey Walker and Associates Inc., 1995). More recent data is available for fishing use, which is thought to be the primary activity at Arrowrock.

Creel surveys completed in 1999 for Arrowrock Reservoir (April to the end of September) show approximately 4,000 visitor-days for fishing based on an average of 5.2 hours per trip (IDFG, 2000). Estimates of winter fishing use at Arrowrock Reservoir are not available but are considered to be low (USFS, 2000a, 2000b, 2000c).

Factors Affecting Use

Early drawdown, as well as poor access contribute to low boating use at Arrowrock Reservoir. Winter boat use figures are not available, but use is considered to be low (USFS, 2000a, 2000b, 2000c). Recreation opportunities are limited by the typically low water elevations which are common in average operating years, particularly during the winter. This limits the ability to recreate and the quality of the experience. When water level reaches elevation 3118 feet, one ramp is unusable; below 3098 feet, both ramps are unusable.

Sightseeing, wildlife viewing, and other non-water dependent activities can occur, but may not be as appealing as water levels drop significantly.

Lucky Peak Lake

Lucky Peak Lake, a Corps facility, is the most popular recreation site within the Boise River system due to its close proximity (11 miles) to the city of Boise. It receives about 790,000 visits per year and 95 percent of the visits originate from Ada County. The reservoir is 12 miles long, has 45 miles of shoreline, and covers 3,019 acres at full pool (3055 feet).[1] The primary recreation activities are: boating; camping/day-use activities, including picnicking; swimming; fishing; and waterskiing.

Spring Shores Marina, located on Lucky Peak Lake, is one unit of Lucky Peak Lake State Park. Lucky Peak State Park is the most heavily used State park in Idaho (Beck & Baird, 1993). Other units of Lucky Peak Lake State Park are Discovery and Sandy Point Beach State Parks which are located just downstream from Lucky Peak Dam.

Lucky Peak Lake has produced excellent fall trout fishing during normal to high water years. Anglers spent an estimated 162,505 hours or roughly 31,250 recreation visits, fishing at Lucky Peak Lake in the 1990-1991 fishing season (Beck and Baird, 1993). The majority of fishing use (60 percent) is in the winter to spring. Bank anglers comprise roughly 57 percent of the total anglers; boaters, 39 percent; and ice anglers, 3 percent.

The optimum reservoir level for recreation purposes is full pool. Boat launching and access sites are particularly sensitive to drawdowns; however, some boat-in sites become inaccessible when the reservoir drops only 5 feet.

The Corps has identified 10 major[2] and 10 minor recreation areas along the shoreline. All of the sites are day use only. Six of the major sites are accessed by automobile and the remainder are accessible only by boat. The most heavily used recreation sites on the reservoir are Spring Shores Marina, Barclay Bay boat ramp, and Turner Gulch boat ramp. In average water years, the reservoir is at full pool throughout the recreation season and all boat launch ramps are functional through that period. During low water supply years, most boat ramps can operate only until mid-July.

In wet water years, Lucky Peak Lake is full for about 2 months, from July 1 to September 1; less time near full pool than in a normal water year due to flood control operations. With the exception of early June, the pool elevation is very good for boating until early September (Shalkey Walker Associates, Inc., 1995).

The most extensive recreation study of Lucky Peak Lake is a boating capacity evaluation published in 1995 by the Corps' Waterways Experiment Station (Confer et al., 1995). Statistics from the study show that Lucky Peak Lake visitors came mostly from the Boise area, and most boaters participated in activities such as water skiing, fishing, picnicking, and swimming. Of the

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[1]Personal Communication with Dave Brownell, Corps of Engineers, September, 2000

[2]Deer Flat, Robie Creek, Spring shores Ramp 1, Spring Shores Ramp 2, Mack's Creek, Placer Point, Charcoal Bay, Barclay Bay, Turner Gulch, Spring Shores Slips

survey respondents, 87 percent said they also boat at other local lakes. Six percent of respondents said they also boated at Anderson Ranch Reservoir and 3 percent said they also boated at Arrowrock Reservoir. The analysis concluded that in 1993, overall boating levels on Lucky Peak Lake had not reached capacity limits, based on an evaluation of the quality of the boater experience. However, identified site specific impacts suggest that some areas were approaching capacity, especially during peak use periods. No comparable study has been completed since publication of the 1993 study; however, the population of the surrounding community has increased by nearly 4 percent per year.

Facilities

Recreation sites are managed by the IDPR and Corps, and all boating launches are from the Spring Shores State Park or Corps ramps. The majority of recreation sites at Lucky Peak Lake are managed by the Corps, and all sites are oriented toward boaters. Many of the recreation sites around the reservoir are accessible only by water due to a lack of road access.

Spring Shores State Park has a 305 slip marina, which is the major source of revenue for the park. Reclamation attempts to maintain a full pool elevation during the summer season to the extent possible within the limits of water supply and irrigation demand. The marina provides mooring from about mid-May to Labor Day during normal and wet years. One recent improvement at the park is a new fixed dock for fuel, the only gasoline available on Lucky Peak Lake. New docks were installed in 1999 and 2000, and the parking lot was expanded to 220 spaces with an additional 100 spaces for vehicles with trailers. The current improvement program was completed in the spring of 2000.

In addition to boat ramps, the Corps has developed and maintains boat-in recreation facilities around the reservoir. Only one of these sites has domestic water; the others are dry. Short-term camping is allowed at these dispersed sites. Annual visits to these sites have been estimated at 33,146 (Corps, 2000).

Numerous docks are provided and maintained by Ada County Parks and Waterways. The county also provides funding for access sites and paid for extending power and lighting from Barclay Bay to Turner Gulch (Corps, 2000). Table 3-12 summarizes boat ramp elevations and management agencies.

Table 3-12. Lucky Peak Lake Boat Ramps (Full Pool Elevation is 3055 Feet)		
Ramp	**Managing Agency**	**Bottom of Ramp Elevation (Feet)**
Robie Creek	Corps	3048
Spring Shores Ramp 1	IDPR	2955
Spring Shores Ramp 2	IDPR	3015
Mack's Creek	Corps	3038
Barclay Bay	Corps	3045
Turner Gulch	Corps	2905
Spring Shores boat slips	IDPR	all wet 3035 all dry 3000
Source: Reclamation, 1999		

The most heavily used boat ramps are Turner Gulch, Barclay Bay, and Spring Shores Ramp 1.

Only three sites charge fees. The boat launch fee at Barclay Bay and Turner Gulch is $2 per day or $25/year. Spring Shores State Park charges a $3 admission fee, with no additional fee for boat launching. Annual boat moorage fees at Spring Shores Marina (Year 2000 season prices) are $546 for 28-foot slips, $437 for 24-foot slips, and $230 for 18-foot slips. The majority of the slips rented are 18 foot.

Recreation Activities

The primary recreation activities are: boating, camping/day-use, which includes picnicking, swimming, fishing, and waterskiing. A large percentage of activities is identified as other, which includes activities not captured in specific use categories.

Although there is no designated swimming beach at Spring Shores, swimming occurs incidental to boating and other activities. There are no developed campgrounds on Lucky Peak Lake. However, camping occurs at the Corps boat-in access sites and at dispersed, primitive locations with sun shelters and/or fire rings (Corps, 2000). Visitors are allowed to stay for up to 3 days. Lucky Peak Lake provides a varied fishery, with small mouth bass in the warm, inshore waters, and rainbow trout and kokanee in the colder, deeper water. Slopes adjacent to Lucky Peak Lake provide hunting opportunities for birds and big game. Chukar, gray partridge, and California quail live on the steep grassy slopes and are hunted heavily. Deer also are hunted on the lands around Lucky Peak Lake, especially during the archery season. Hunting pressure is reported to be high in this area (Beck and Baird, 1993).

Wildlife viewing is popular, especially in the winter. Visitors park and watch the hillsides for herds of deer and look for bald and golden eagles which are concentrated in this area in the winter.

Recreation Use

Lucky Peak Lake is the most heavily used flat water recreation site in the Boise River system. The Corps maintains a counter on Forest Road 286 just east of Spring Shores State Park and estimates that 153,916 visitors passed that point in the 1-year period from October 1, 1998 to September 30, 1999.

The Corps maintains six counters at strategic locations along the reservoir to help estimate visitor numbers and recreational activities and to monitor trends. A study completed in 1993 verified the methodology for estimating various uses based on the raw count data.

The number of visitors in a year depends on several factors including pool elevation, weather, and access problems due to construction activities. Table 3-13, which shows recent visits by site, was developed from cumulative visitor data provided by the Corps. Table 3-14 shows the distribution of visits by month. Corps data are annually reported by water year (October 1 to September 30).

Table 3-13. Lucky Peak Lake Recreation Visits

Site	1998-1999 Recreation Visits
Lucky Peak Dam[1]	147,639
Barclay Bay & Turner Gulch	206,553
Spring Shores	153,916
Robie Creek	108,396
Boat access sites (dispersed camping)	33,146
Macks Creek	27,334
Other	113,000
Total (rounded)	790,000

[1]Lucky Peak Dam incorporates day-use sites in the vicinity of the dam
Source: Corps, 1999

Recreation use at Lucky Peak is varied as shown in table 3-14. Boating, swimming, fishing, and waterskiing account for about 43.5 percent of total use.

Table 3-14. Lucky Peak Lake - Use by Activity	
Activity	**Percent of Total Use**
Other	38
Boating	17
Camping/Day-use	16
Swimming	11
Fishing	8.5
Waterskiing	7
Sightseeing	2.5
Hunting	0.16
Total (rounded)	100

Season of Use

The primary recreation season extends from Memorial Day to Labor Day. Although use drops off significantly after Labor day, late season use continues into the fall as long as weather conditions permit. Some winter fishing use occurs as well. Table 3-15 summarizes recreation use by month.

Table 3-15. Lucky Peak Lake Use by Month	
Month	**Percent of Total Use**
October	4
November	3
December	2
January	2
February	2
March	4
April	5
May	6
June	18
July	28
August	20
September	6
Total (rounded)	100

Spring Shores Marina use is highest from June through August with the highest month of use being June.

Factors Affecting Use

Reservoir elevation has the greatest affect on water-dependent recreation use at Lucky Peak Lake. Use which takes place independent of water levels, such as sightseeing, driving for pleasure, picnicking, are not affected to the same degree as water-dependent activities, such as boating, water skiing, swimming, etc.

As the water levels drop, shoreline docks become unavailable and shade shelters become inaccessible. Increased distance to shoreline facilities due to reservoir drawdown inconveniences users and results in a 'bath tub ring', which is less attractive than a full reservoir.

During normal and wet water years, all boat ramps are usable on or before Memorial Day through Labor Day. During drought years, the early drawdown substantially affects boating use. Barclay Bay, Robie, and Macks Creek ramps become inoperable early in a dry year. As the Barclay Bay ramp becomes inoperable and the Spring Shores ramp approaches this situation, use pressure increases on the Turner Gulch ramp. Boat-in access sites are particularly sensitive to drawdowns. Many of these sites become inaccessible when the lake drops only 5 feet. The Spring Shores boat marina and support facilities, such as irrigation pumps, are designed to function at near full-pool levels. Drawdown levels which reduce boat slip moorage affects marina users.

Reduced water surface at Lucky Peak can cause congestion, as diverse types of water craft compete for limited space. In addition, reduced water levels can result in boating safety concerns related to submerged and partially submerged hazards (rock outcropppings, sand bars, wood, etc.).

Lower Boise River

The Boise River is a tremendous asset within Ada County and, along with the parks and Greenbelt, is a continuing source of community pride. Not only does the river offer a diverse range of recreational opportunities, it provides great esthetic benefits. The Boise River Festival, which originally centered around the river in downtown Boise, is a multi-day celebration of the connection of the river and community. The festival draws more than 1 million people annually and provides a sizable economic contribution to the community. This annual festival takes place the last week of June.

There are about 64 miles of Boise River between Lucky Peak Dam and the confluence with the Snake River. Most of the recreational use of the river occurs in the 10 miles through the city of Boise, roughly from Barber Park to Glenwood Bridge. In this reach, land based recreation along the river assumes great importance, as contrasted to reservoirs where land based recreation is less important.

The river flows through a protected riparian corridor along which Boise has developed five large urban parks, and all are connected by the Greenbelt, an extremely popular pedestrian/bikepath which parallels the river from Lucky Peak Dam to Eagle Island. Recreation along this reach occurs in a mostly urban setting. One is never far from streets, houses and people, although the riparian area and the sound of the water provide a non-urban feeling in places.

Recreation Facilities

At the toe of Lucky Peak Dam is Sandy Point Beach State Park which has a swimming beach and extensive lawn areas for picnicking. Concerts are held there in the summertime. Discovery Park, just a few hundred feet downstream from Sandy Point Beach State Park, has shade and grassy picnic areas along the river. As stated earlier, Sandy Point Beach and Discovery State Parks, along with Spring Shores Marina comprise the three units of Lucky Peak State Park, the most heavily used State park in Idaho (Beck & Baird, 1993).

Boise River Diversion Dam, located about 3.5 miles downstream from Lucky Peak Dam, is a primary diversion point for irrigation water (New York Canal) and diverts a larger portion of the outflow of Lucky Peak Dam during the irrigation season. About 2 miles further downstream is Barber Park which is the starting point for a locally-renowned summer pastime of floating the Boise River.

Barber Park is a 22-acre, fee-use park owned and maintained by Ada County. Facilities include a non-motorized put-in, concession stand where rafts and inner tubes are rented, a day-use park with facilities for group use, and parking for about 800 vehicles. River floaters launch inner tubes and rafts for the 5-mile float into the center of the city of Boise. During winter, watching bald eagles along the river near the park is popular. The Barber Park concessions provided by Ada County are the only major source of revenue for Ada County Parks and constitute nearly 100 percent of the annual operating budget.

The primary land based recreation along this reach of river is on the Boise River Greenbelt path, which extends from Discovery Point State Park just downstream from Lucky Peak Dam to beyond the Glenwood Bridge. The path, constructed along both sides of the river in some places but along only one side of the river in others, is for the most part adjacent to the water. At higher riverflows, some parts of the path are inundated. The Greenbelt is heavily used by bicyclists, joggers, walkers, and in-line skaters and is used by some commuters. The river provides an esthetic backdrop, a place to wade, and a place to connect with nature in the city. The many volunteer paths between the river and the Greenbelt path provide a visible, physical link between the land and water.

Other facilities along the river further downstream include Municipal Park, Julia Davis Park, Ann Morrison Park, Veterans Memorial State Park, and Eagle Island State Park.

Admission fees are charged only at Sandy Point Beach and Discovery State Parks ($3.00 per day) and at Barber ($4.00 per day to park). Ada County Parks also charges $2.00 for shuttle services for river floaters. Innertube rentals are extra.

Recreation Activities

The primary recreation activities on the river are summer 'tubing' or floating, non-motorized boating, fishing and general day-use activities associated with the Boise River Greenbelt.

When the river flow drops sufficiently in early summer, Ada County Parks and Waterways and Boise City Parks and Fire Department staff survey the river for hazards to tubers and boaters. When the worst hazards are cleared, and officials agree, the river is declared "open" for tubing and floating (Ada County, 2000).

Boating on this river reach varies according to the amount of water in the river. Motorized boating is prohibited from much of the reach by city of Boise ordinance. During high, spring flows, experienced kayakers and whitewater enthusiasts use waves created by irrigation diversions to play and to practice maneuvers. At lower flows, novice and beginning kayakers, and canoeists, use the river to develop skills. The Boise River is increasing in popularity with canoeists. At least one outfitter is licensed to provide guided trips on the river reach downstream of Glenwood Bridge (Ada County, 2000).

The main stem Boise River is open to fishing year around and provides a popular put-and-take fishery. River management goals are to enhance the habitat, stock the river seasonally with fingerling brown trout and adult steelhead, stock catchable rainbow trout year around, screen diversions to prevent loss of large fish, and manage the river for a high density of anglers. IDFG stocked approximately 40,000 catchable hatchery rainbow trout between Barber Park and Glenwood Bridge during 1999. The fishery is urban and is currently managed to provide a high percent return-to-creel.

The riparian corridor along this reach of the Boise provides homes to songbirds, water birds, and birds of prey. Wildlife viewing is popular along the Greenbelt and Boise River. Kayakers and canoeists float the river between April and June when flows are 1,500-3,000 cfs. This volume of flow forms a Class III rapid, appropriate for intermediate and advanced kayakers, at a weir in downtown Boise.

Recreation Use and Season of Use

The greatest amount of water based recreation on this reach of river is tubing, people floating the river in innertubes or small rafts. A popular river run is from Barber Park on the City's eastern boundary to Ann Morrison Park, about 4 river miles downstream. Barber Park accommodates over 10,000 river floaters per day in the summer months (Beck and Baird, 1993). Exact counts are not known, but estimates are that at least 10,000 people float the river on warm days throughout the summer months from July to September (Ada County, 2000). Ann Morrison Park, at the lower end of the floatable section, is the most popular takeout point. After public schools start in the fall, floating drops to about 100 people per day.

In 1994, fisheries managers estimated there were 70,000 hours of fishing effort between Barber Park and Glenwood bridge, up from an estimated 50,000 hours of effort in 1987. During the same interval, the number of fly fishermen increased an estimated 10 percent, to account for 18 percent of fishermen (Boise Parks and Recreation, 1999).

The tubing season begins when river flows drop to 1,500 cfs and the air temperature warms, usually in early-to-mid-July. The tubing season generally ends after Labor Day, when services are no longer provided at Barber Park. Fishing is open all year. Day-use activities, including use of the Boise River Greenbelt, occur all year, weather and other conditions permitting.

Table 3-16 summarizes recreation use by month.

Table 3-16. Estimated 1999 Visitation on Boise River Downstream of Boise River Diversion Dam

Month	Current Estimated Use
May	17,500
June	17,500
July	87,500
August	175,000
September	52,500
Total	350,000
Source: Reclamation (1999)	

Table 3-17 summarizes percentage of use of Sandy Point Beach and Discovery State Parks by month. Use is year-round but concentrated in June through August.

Table 3-17. Lucky Peak State Park (Sandy Point Beach & Discovery State Park Units)Use By Month (Percent of Total)

Month	Percent of Annual Use
April	5
May	6
June	18
July	28
August	20
September	6
Oct-March	17
Total	100

Factors Affecting Use

Suspended sediment or other factors affecting water quality in the Sandy Point Beach area may discourage swimming and wading.

Flows greater than 1,500 are generally considered to be unsuitable for floating and tubing on the Boise River below Barber Park to Glenwood and for swimming and wading. Flows greater than 4,000 are considered unsuitable for fishing, as shoreline wading becomes difficult. At high flows fly- and bait-fishing is less successful, due to swift water and suspended sediments.

The Boise River Greenbelt was designed to accommodate occasional high flows. Flooding of some portions of the Greenbelt occurs at flows greater than 5,000 cfs, causing cyclists, walkers, and joggers to detour around the flooded area if possible.

Anderson Ranch Reservoir

Anderson Ranch Reservoir is located on the South Fork Boise River approximately 28 miles northwest of Mountain Home, Idaho. Completed in 1945, the dam is the furthest upstream of three dams built on the Boise River. Recreation at Anderson Ranch Reservoir is managed by the Boise National Forest. When full, the reservoir has a surface area of 4,700 acres, a length of 14 miles, a width of 1 mile, a shoreline 50 miles long, and a depth of 315 feet.

Many of the visitors are from Mountain Home and the Wood River Valley (Shalkey Walker and Associates Inc., 1995). Anderson Ranch Reservoir is typically drawn down early in the summer recreation season to provide water for irrigation and to maximize power production. In most years, the reservoir does not meet its full potential as a recreation site due to lack of water (Beck and Baird, 1993). The slopes around the reservoir are steep and much of the shore is not accessible by road both of which hinder the ability to develop recreation sites.

Recreation Facilities

Anderson Ranch facilities include vault toilets, boat ramps, and docks. USFS campgrounds include Deer Creek (30-units), Curlew Creek (25-units), and Fall Creek (20-units). There are eight boat ramps on Anderson Ranch Reservoir, and all are typically operable throughout the prime recreation season from May through September. Two ramps are dry prior to Labor Day and the others operate for the entire 5-month recreation season. Fall Creek High is dry by mid-August and Elk Creek Low is typically dry by September 1.

The shoreline is accessible to anglers along the northwest side from the Anderson Ranch Dam to Fall Creek where streams enter the reservoir. Bank anglers also have good access at the upper end of the reservoir from Lime Creek to the Pine boat ramp. Undeveloped camp sites are available along the shoreline near the road and several sites are accessible only by boat. Privately managed developed camp sites are available in resort areas of Pine, Deer, and Fall creeks.

No fees are charged at public boat ramps.

Recreation Activities

Fishing, hiking, boating, camping, and waterskiing are the major recreation activities. Anderson Ranch Reservoir supports a mixed cool and cold water fishery, that includes wild and hatchery rainbow trout and kokanee salmon, which are best caught in the summer months and fall throughout the reservoir. Wild rainbow trout move down stream into the reservoir during early spring and late fall. Both hatchery and rainbow trout can grow to 5 pounds or more while in the reservoir. Good spawning conditions in tributary streams provide a continuous supply of kokanee salmon which makes Anderson Ranch Reservoir one of the more popular kokanee fisheries in southern Idaho (Beck and Baird, 1993). Bull trout are also found in the reservoir, but must be released due to their protected status under the ESA.

Recreation Use and Season of Use

Anderson Ranch Reservoir is used by recreationists in the spring, summer, and fall. Severe weather conditions and hazardous roads minimize winter use. Fishing is open year-round.

In 1990, recreation use at Anderson Ranch Reservoir was estimated at 68,600 visitors. The primary use is fishing and associated activities, such as camping, and general boating. Summer is the primary recreation use season.

Factors Affecting Use

Due to irrigation demands, significant drawdown in late summer may affect ramp access. However, Curlew ramp, at the upper end of the reservoir, and Elk Creek ramps are nearly always available.

South Fork Boise River

This river reach is 28 miles long to the backwater of Arrowrock Reservoir, with 12 miles accessible by road. It can be reached from Boise in about 2 hours on a combination of paved and unpaved roads. Visitors come from throughout south-central Idaho for white water rafting and high quality fishing, depending on the river flow and season. Lands on both sides of the river are mostly public, part of the Boise National Forest managed by the Mountain Home Ranger District. The stream reach from Anderson Ranch Dam to Black Canyon Creek is designated as a State Protected Recreational River. From the mouth of Black Canyon Creek to a point 250 yards upstream of Neal Bridge, the river is designated a natural river (Shalkey Walker and Associates Inc., 1995).

This river reach consists of two sections, one with road access and the other without road access. The upper section is an easy float for beginners and others who boat primarily to fish. The best flows are between 600 and 2,000 cfs. The Village boat access, about 2.5 miles downstream from Anderson Ranch Dam, provides a place to access the Class II section of river. Cow Creek Bridge, about 5 miles downstream from the Village access, is another popular access point.

Danskin Bridge, about 3.5 miles downstream from Cow Creek Bridge, provides a place to leave the easy stretch of the river or to put-in for the white water section. There is a restroom, parking area, registration box, and launch area. However, user data is not compiled from this information.

The popular white water run is in the roadless canyon section between Danskin and Neal Bridges. It is a Class III run at flows between 600 and 1,800 cfs (Reclamation, 2000b). Optimum boating flows are from 1,000 to 3,000 cfs; difficulty increases above 1,800 cfs. Normal water years provide a boating season from May to September. At present, no permits have been issued to outfitters and guides for this river reach.

Although the canyon float can be completed in half a day, many boaters camp at several dispersed sites in the canyon. In response to the number of users, the USFS installed a primitive toilet in the canyon section at Devil's Hole.

Neal Bridge, the take-out site for the white water run, is just upstream from the slack water of Arrowrock Reservoir.

The South Fork Boise River is a blue-ribbon trout fishery which has been rated by Trout Magazine as one of the 100 top trout streams in the United States (Beck and Baird, 1993). Marv Taylor, in his book, *Idaho's Top 30 Fishing Waters*, says there are three "seasons" for fishing the South Fork. The first is June through August, which is drift boat season. With flows ranging from 600 to 1,600 cfs, the river is difficult to wade. The second season begins in early fall when flows from Anderson Ranch Dam are reduced to 300 cfs. This low flow and the fall hatches of insects offer excellent fishing, making September and October the best months on the river. The third season is the winter whitefish season. With continued low flows, the river is easily fished "and is a great joy to avid whitefish anglers" (Taylor, 1990).

The South Fork Boise River is designated as a special trout stream. From Anderson Ranch Dam to Neal Bridge, only artificial lures may be used. The trout limit is two, and trout 12-20 inches long must be released.

Recreation Facilities

There are no developed campgrounds or recreational facilities, with the exception of boater access sites; however, there is a large amount of dispersed camping. Boater access sites do not charge fees.

Recreation Activities

Whitewater rafting, fishing, associated day-use activities and dispersed camping are the primary recreation activities in this reach.

Recreation Use and Season of Use

The primary recreation season for whitewater rafting is dependent on favorable flows and weather conditions, but generally high use occurs in the spring and summer. Fishing occurs from early summer, fall and winter, depending on flow conditions.

No use figures available

Factors Affecting Use

The type of recreation use will change depending on the flows. For example, flows which are considered too high for fishing, above 1,600 cfs, are considered suitable for whitewater rafting. Flows which may be considered too low for rafting, may be suitable for fishing, 300 to 600 cfs.

Environmental Consequences

This section includes impacts to water-based recreation, associated recreation, mitigation, and residual effects for each alternative. Winter recreation from December 1 to March 1 is generally not considered in this analysis due to a lack of data on recreation use and the minor amount of water based recreation that takes places in those months. Impacts of the alternatives were analyzed for wet conditions, average conditions, and dry conditions as reservoir levels and riverflows can be substantially different depending on annual runoff.

Impact Indicators/Methods for Evaluating Impacts

Many factors influence the quality and abundance of water-based recreation use; reservoir and river access, water levels related to safety, crowding, fisheries, water-quality, user-conflicts, and others. Water-based recreation effects are determined by comparing flow and elevation parameters for each site against projected hydrologic conditions for each alternative. The magnitude of impact depends on the amount, timing and duration of the hydrologic condition. This, in turn, shows an effect on impact indicators. Water-based recreation, impact indicators are the ability to launch boats, fish, swim, and float or raft; not all impact indicators apply to all sites.

In general, this analysis assumes that hydrologic conditions which permit primary water-based activities to occur have a positive effect. Likewise, conditions which prohibit key activities have a negative effect. The impact indicators identified above are quantitatively measured where information is available. Impacts to activities which are non-water based and not quantitatively measured are qualitatively assessed based on professional judgement. These include camping, hunting, sight seeing, wildlife viewing, esthetics, and other day-use activities.

To measure changes in use associated with the impact indicators, river flow and reservoir elevation parameters have been established. Parameters are flow and reservoir levels at which measurable change, both good and bad, can be measured. For example, parameters have been established for reservoir access based on the ability to use boat launch ramps. End of ramp elevations indicate the reservoir level at which ramps become unusable (see tables 3-11 (Arrowrock Reservoir) and 3-12 (Lucky Peak Lake).

Flow parameters for the lower Boise River are summarized in table 3-18 and flow parameter for the South Fork Boise River are summarized in table 3-19.

Table 3-18. Lower Boise River Flow Parameters for Floating, Fishing, and Green Belt Use (Barber Park to Glenwood Bridge)

Activity	Flow (Cubic Feet per Second)[1]	Duration
Floating	≤ 1,500	Memorial Day - Labor Day
Fishing	≤4,000	Year-round
Greenbelt Use	≤5,000	Year-round

[1]Represents the highest flow at which the activity occurs.

Table 3-19. South Fork Boise River Flow Parameters for White Water Rafting and Fishing

Activity	Flow (Cubic Feet Per Second)	Duration
White Water Rafting[1]	600-2000	Memorial Day - Labor Day
White Water Rafting[2]	600- 800 (good) 1,000-3,000 (optimal)	Memorial Day - Labor Day
Fishing	600-1,600	June - August
Fishing	300	September and October
Fishing	300	November - May

[1]Village Boat access to Cow Creek Section
[2]Danskin Bridge to Neal Bridge

Impact indicators for recreation vary by site. The following impact indicators were used for this analysis of recreation effects:

- Arrowrock Reservoir – Ability to: launch boats, fish, and swim.
- Lucky Peak Lake – Ability to: launch boats, water ski, fish, and swim
- Lower Boise River – Ability to: float, fish, swim, and use the Boise River Greenbelt
- Anderson Ranch Reservoir – Ability to: launch boats, water ski, and fish
- South Fork Boise River – Ability to: white-water raft and fish

No Action

Arrowrock Reservoir

Table 3-20 summarizes the effects of No Action on Arrowrock Reservoir elevation with respect to boat ramp usability. Boat ramp availability would be different only in October and November,

a time when the water elevation would be rising under normal operations. There would be no change in ability to boat, fish and swim from May through mid-September from normal operating conditions. Under the No Action alternative in the fall, reservoir levels decline (to 3007 feet in some maintenance years and 2975 feet in other maintenance years) and level off, leaving the two existing ramps out of the water.

Table 3-20. No Action Alternative, Arrowrock Reservoir Elevation and Boat Ramp Usability (Total of 2 Ramps)[1]

Months	Arrowrock Reservoir Elevation (Feet)			Number of Boat Ramp Usable		
	No Action		Normal Operations[2]	No Action		Normal Operations[2]
	Average Year	Wet Year		Average Year	Wet Year	
May 1 to September 30 – Minor reservoir elevation differences, no differences in usability of boat launch ramps						
October	3007 or 2975	3007 or 2975	3132	None	None	2
November	3007 or 2975	3007 or 2975	3155	None	None	2

[1]End-of-month elevations; full pool elevation is 3216 feet.
[2]Years when Arrowrock Reservoir would not be drafted for maintenance.

Inability to launch boats in October and November would have a very minor negative effect, as recreation use is low at this time of year. Fall hunters who boat-in to hunting sites would be forced to find other means of access to hunting sites. Wildlife viewing should not be affected. The esthetic quality of the reservoir would diminish due to increased reservoir shoreline, or bath-tub ring.

Lucky Peak Lake

Table 3-21 summarizes the differences between a No Action maintenance year and normal non-maintenance operations.

Table 3-21. No Action Alternative, Lucky Peak Lake Elevations and Boat Ramps Available in an Average Water Year (Total of Six Ramps)[1]

Months	Lucky Peak Lake Elevation (Feet)		Number of Ramps Usable	
	No Action	Normal Operation	No Action	Normal Operation
May 31-August 15 – Minor reservoir elevation differences but no difference in boat ramp usability				
August 31	3029	3055	3	6
September 15	3007	3017	2	3
September 30 - November 30 – Minor reservoir elevation differences but no difference in boat ramp usability				

[1]End of month elevations unless otherwise shown; full pool elevation is 3055 feet.

The primary No Action effect is that Lucky Peak Lake elevation would be lower from the end of August to mid-September, shortening the recreation season by about 1 week. However, the three most highly used ramps (Spring Shores 1, Barclay Bay, and Turner Gulch) would remain in the water through the end of August and two ramps (Spring Shores 1 and Turner Gulch) would remain in the water beyond the recreation season.

The ability to launch boats, water ski, fish, swim would be affected somewhat and may be felt in terms of crowding at the three remaining functional ramps in late August (two by mid-September). To some degree, the reduced water surface on the reservoir may result in user conflicts due to boater congestion.

The No Action Alternative would cut the recreation season short for the marina, requiring boat slip lessees to pull their boats out of the water at least one week earlier than under normal operating conditions. All moorage slips are useable at 3035 feet, but begin coming out of the water below this level. At elevation 3017 feet, one-half of the slips become unusable, no slip is available at elevation 3000 feet.

The lower water elevation would also affect late season use of irrigation pumps, which becomes inoperable at 3040 feet; boat fuel sales, delivery would be impossible at 3029 feet; and other facilities and services provided at the marina. Some users would be forced to forego late season recreation use or go elsewhere to recreate. As a result Spring Shores would suffer some loss of revenue associated with the entry fee.

Effects on camping/day-use, sightseeing, esthetics, and 'other activities' should be minimal. These activities are not directly dependent on reservoir access and can continue regardless of changes in boat ramp access. The effect would occur late in the recreation season and would not be expected to have a large effect on these or primary activities.

About 43.5 percent of overall use at Lucky Peak is directly affected by boat ramp access and 26 percent of recreation use occurs in August and September. The No Action alternative would reduce boat ramp access from 6 ramps to 3 at the end of August, and from 3 ramps to 2 by September 15. However, this would affect only a small portion of the primary recreation season and the primary use ramps would still be available. As a result, recreation-day losses would be minimal under the No Action Alternative.

Non-water dependent activities such as camping/day-use, sightseeing, esthetics, etc. would not likely be affected to a measurable extent.

Lower Boise River

In an average water year, No Action would have no effect on the flows of the lower Boise River during the summer floating season, i.e., flows would be the same as in a non-maintenance year.

In a wet year of Maintenance Season 1, flows would be higher (1,500-1,700 cfs) in August through October, which would prohibit most floating recreation. In a wet year of Maintenance Season 3, there would be flows of 4,500 cfs beginning in July, dropping to 2,000 cfs in August,

and dropping further to 1,200-500 cfs in September. This would eliminating floating and fishing opportunities for the entire recreation season. There is a 15 percent probability of having a wet year in any single maintenance season and a 5 percent probability of having wet year conditions in Maintenance Season 1 and 3.

No Action maintenance years would have no effects on day-use and other activities under average water year conditions.

Anderson Ranch Reservoir

With No Action, Anderson Ranch water level would be equal to or greater than normal operations in June and July in maintenance years. In August, September, and October, water levels would be 10-30 feet higher than with normal operations. These higher water levels would provide a positive effect. Boat ramps which become unusable late in the recreation season under normal operating conditions, would be useable under the No Action Alternative. There would be a positive impact to late recreation season use under the No Action Alternative. Hiking, camping/day-use, sightseeing, and esthetics would also be enhanced.

South Fork Boise River

Flows of the South Fork Boise River would not be altered by the No Action Alternative. As a result, No Action would have no effect on recreation in this river reach.

Mitigation and Residual Effects

Although the impacts identified under the No Action Alternative are minimal (late season drawdown of Arrowrock Reservoir and drawdown at Lucky Peak approximately one-week earlier than Labor Day), the impacts would occur in 9 years of a 50 year period.

Mitigation measures were not identified. Drawdown of Lucky Peak Lake prior to Labor Day would result in an unmitigated, residual impact to some recreationists due to reduced lake surface one-week prior to the end of the recreation season. It would also potentially result in lost revenue to Spring Shores marina and other reservoir sites.

Alternative A (Preferred Alternative)

Arrowrock Reservoir

Tables 3-22 and 3-23 summarize Arrowrock Reservoir elevations and the availability of boat ramps in the three construction seasons. There would be a slight recreation benefit in Construction Seasons 1 and 2 under average and wet conditions. In Construction Season 3, one of the two ramps would be useable to near the end of August, but neither ramp would be useable by mid-September. There would be a slight negative impact, from the end of August, affecting fall reservoir use.

Table 3-22. Alternative A (Preferred Alternative), Arrowrock Reservoir Elevations and Boat Ramp Usability Construction Seasons 1 and 2 (Total of 2 Ramps)[1]						
	Arrowrock Reservoir Elevation (Feet)			Number of Boat Ramps Usable		
	Alternative A		Normal Operations[2]	Alternative A		Normal Operations[2]
Months	Average Year	Wet Year		Average Year	Wet Year	
May 1 to August 15 – Minor reservoir elevation differences but no differences in usability of boat ramps						
August 15	3114	3119	3092	1	2	None
September 15	3114	3119	3086	1	2	None
September 15 to November30 – Minor reservoir elevation differences, no differences in usability of boat ramps						
[1]End-of-month elevations unless otherwise indicated; full pool elevation is 3216 feet. [2]Years when Arrowrock Reservoir would not be drafted for maintenance.						

Table 3-23. Alternative A (Preferred Alternative), Arrowrock Reservoir Elevations and Boat Ramp Usability Construction Season 3 (Total of 2 Ramps)[1]						
	Arrowrock Reservoir Elevation (Feet)			Number of Boat Ramps Usable		
	Alternative A		Normal Operations[2]	Alternative A		Normal Operations[2]
Months	Average Year	Wet Year		Average Year	Wet Year	
May 1 to September 15 – Minor reservoir elevation differences, no differences in usability of boat launch ramps						
September 15	3023	3024	3086	None	None	None
October	3023	3024	3132	None	None	2
November	3023	3024	3155	None	None	2
[1]End-of-month elevations unless otherwise indicated; full pool elevation is 3216 feet. [2]Years when Arrowrock Reservoir would not be drafted for maintenance.						

Lucky Peak Lake

Table 3-24 summarizes Lucky Peak Lake elevations and boat ramp availability in Construction Seasons 1-3. Alternative A effects in each year would be essentially the same as that in maintenance years of the No Action Alternative. Reservoir elevations would be essentially identical in average and wet conditions and in all construction seasons.

Table 3-24. Alternative A (Preferred Alternative), Lucky Peak Lake Elevations and Boat Ramps Available in Construction Seasons 1-3 with an Average Water Year (Total of Six Ramps)[1]				
	Lucky Peak Lake Elevation (Feet)		Number of Ramps Usable	
Months	Alternative A	Normal Operation	Alternative A	Normal Operation
May 31-August 31 – Minor reservoir elevation differences but no difference in boat ramp usability				
August 31	3023	3055	3	6
September 15	2992	3017	2	3
September 30 - November 30 – Minor reservoir elevation differences but no difference in boat ramp usability				
[1]End-of-month elevations unless otherwise indicated; full pool elevation is 3055 feet.				

Lower Boise River

Table 3-25 summarizes river flow impacts on the lower Boise River in Construction Seasons 1 and 2. The only recreation impact would be reduced opportunity to float the river from mid-July through the first part of August if it is a wet water year; flows would exceed 1,500 cfs. This is a high use period, accounting for approximately 25 percent (43,750 recreation-days) of the total use. Lost revenue to Ada County, at Barber Park due to reduced parking and shuttle use is estimated at $105,000. This does not include lost revenue from Barber Park rental fees. In addition, there could be increased law enforcement and search and rescue costs associated with flows higher than 1,500 cfs during the prime recreation season. Even though the river might be declared unsafe and closed to floating, some would float the river.

There is roughly a 15 percent probability that a wet water year would occur in any construction season and only a 5 percent probability that two wet water years would occur consecutively.

Table 3-25. Alternative A (Preferred Alternative), Lower Boise River Flows in Construction Seasons 1 and 2 with Average and Wet Water Years[1]					
	Boise River Flows (Cubic Feet Per Second)			Recreation Effects	
	Alternative A		Normal Operations[2]	Alternative A	
Months	Average Year	Wet Year		Average Year	Wet Year
May 1 to June 30 – Minor river flow variations but no differences in recreation opportunities					
July	No Change	2,127	1,300	None	Reduced Floating
August 15 to November 30 – Minor river flow variations but no differences in recreation opportunities					
[1]End-of-month unless otherwise indicated. [2]Years when Arrowrock Reservoir would not be drafted for construction.					

Table 3-26 summarizes the riverflow impacts of Alternative A in Construction Season 3. Construction Season 3 would have no effect on recreation under average water conditions. If the year is wet, river flows would be too high for floating from the end of July to the end of August; flows would exceed 1,500 cfs. August floating use accounts for roughly one-half (175,000 recreation-days of use) of the annual Boise River floating use. Lost revenue of approximately $420,000 is estimated due to reduced parking and shuttle use.

Table 3-26. Alternative A (Preferred Alternative), Lower Boise River Flows in Construction Season 3 with Average and Wet Water Years[1]

Months	Boise River Flows (Cubic Feet Per Second)			Recreation Effects	
	Alternative A		Normal Operations[2]	Alternative A	
	Average Year	Wet Year		Average Year	Wet Year
May 1 to June 30 – Minor river flow variations but no differences in recreation opportunities					
July	Normal	2,100	1,300	None	Reduced Floating
August 15	1,444	1,750	1,300	None	Reduced Floating
August 31	1,440	1,550	1,300	None	Reduced Floating
September 30 to November 30 – River flow variations but no differences in recreation opportunities					

[1]End-of-month unless otherwise indicated.
[2]Years when Arrowrock Reservoir would not be drafted for construction.

Anderson Ranch Reservoir

Recreation impacts under Alternative A would the same as for the No Action Alternative.

South Fork Boise River

Alternative A would have little impact on flow of the South Fork Boise River and would not affect recreation opportunities.

Mitigation and Residual Effects

Reclamation would conduct an aggressive public information and outreach effort prior to and during construction in order to notify the public of potential safety hazards from operational changes and alternative recreation opportunities. This effort would be particularly intensive prior to Construction Season 3 when reservoir levels and river flows would change most.

Drawdown of Lucky Peak Lake prior to Labor Day would result in an unmitigated, residual impact to some recreationists due to reduced lake surface 1 week prior to the end of the recreation season. Overall, recreation-day losses would be minor.

Reclamation would conduct an aggressive public information effort during construction, especially prior to year 3 when reservoir levels and river flows would change most. The public would be notified well in advance of operational changes at the reservoirs and in the river, potential safety problems, and alternate boating sites.

Float boating impacts on the lower Boise River in wet water years, for July and August would not be mitigated. This could result in a loss of up to 175,000 recreation-days of use. There is only a 15 percent chance that third construction year would be a wet water year. Residual impacts of Alternative A would be short term, lasting only through the construction period. Thereafter, reservoir operations would return to normal.

Alternative B

The effects of Alternative B through the first two construction seasons would be the same as Alternative A. This section focuses on construction year 3.

Arrowrock Reservoir

Table 3-27 summarizes Alternative B impacts on Arrowrock Reservoir elevations and boat ramp availability in Construction Season 3. The recreation impacts would be about the same as for Alternative A in Construction Season 3.

Table 3-27. Alternative B, Arrowrock Reservoir Elevations and Boat Ramp Usability Construction Season 3 (Total of 2 Ramps)[1]

Months	Arrowrock Reservoir Elevation (Feet)			Number of Boat Ramps Usable		
	Alternative B		Normal Operations[2]	Alternative B		Normal Operations[2]
	Average Year	Wet Year		Average Year	Wet Year	
May 1 to September 1 – Minor reservoir elevation differences but no differences in usability of boat ramps						
October	3007	3007	3132	None	None	2
November	3007	3007	3155	None	None	2

[1]End-of-month elevations unless otherwise indicated; full pool elevation is 3216 feet.
[2]Years when Arrowrock Reservoir would not be drafted for maintenance.

Lucky Peak Lake

Table 3-28 summarizes Lucky Peak Lake elevations and boat ramp availability for Alternative B in Construction Year 3.

Table 3-28. Alternative B, Lucky Peak Lake Elevation and Boat Ramps Available in Construction Season 3 with an Average or Wet Water Year (Total of Six Ramps)[1]				
	Lucky Peak Lake Elevation (Feet)		Number of Ramps Usable	
Months	Alternative B	Normal Operation	Alternative B	Normal Operation
May 1-July 15 – Minor reservoir elevation differences but no difference in boat ramp usability				
July 31	3039	3055	3	6
August 15	3012	3055	2	6
August 31	2979	3055	2	6
September 15	2962	3017	2	3
September 30 - November 30 – Minor reservoir elevation differences but no difference in boat ramp usability				
[1] End of month elevations, unless otherwise indicated; full pool elevation is 3055 feet.				

Alternative B would have large, negative effects to primary water-based activities at Lucky Peak Lake, reducing the number of ramps to three at the end of July and to two from mid-August through the remainder of the recreation season. This period of effect is the primary recreation season, accounting for approximately 40 percent of use (assumes roughly one-half of July and all of August would be affected). The activities affected would include boating, swimming, fishing, and water skiing, which comprise 43.5 percent of the use. Alternative B could result in a loss of approximately 103,100 recreation-days of use related to reduced boat ramp access.

Alternative B would significantly affect Spring Shores Marina due to the deep drawdown during the height of the recreation season. Low pool levels at the end of July would require some marina users to remove boats in July, as opposed to after Labor Day. This would negatively impact some users, causing some users to forego a large portion of the recreation season or to go elsewhere to recreate. As water levels drop below elevation 3040 feet, irrigation pumps become inoperable and below elevation 3029, the fuel dock become inoperable. All moorage slips are useable at 3035 feet, but begin coming out of the water as the water surface drops lower. As water levels drops to 3017 feet, one-half of the slips become unusable and none of the slips are usable at water surface elevation of 3000 feet. There would be a loss of entrance fees. Other facilities and services provided at the marina would also be negatively affected.

Lower Boise River

Table 3-29 summarizes flows of the lower Boise River and the recreation opportunities affected.

Table 3-29. Alternative B, Lower Boise River Flows in Construction Season 3 with Average and Wet Water Years[1]					
	Boise River Flows (Cubic Feet Per Second)			Recreation Effects	
	Alternative B		Normal Operations[2]	Alternative B	
Months	Average Year	Wet Year		Average Year	Wet Year
May 1 to June 30 – Minor river flow variations but no differences in recreation opportunities					
July	2,303	5,000	1,300	Reduced floating	
August 15	2.318	3,500	1,300	Reduced floating and fishing	
August 31	2,606	2,868	1,300	Reduced Floating	
September 30 to November 30 – River flow variations but no differences in recreation opportunities					

[1]End-of-month unless otherwise indicated.
[2]Years when Arrowrock Reservoir would not be drafted for construction.

Alternative B in the third construction season would have significant adverse impacts to floating from the end of July through August under average and wet water years; flows would substantially exceed the 1,500 cfs flow target for floating. August accounts for roughly half (175,000 recreation days) of the total annual floating use on the Boise River. Alternative B in the third construction season would eliminate revenue associated with float tube rentals, entry fees at Barber Park and other concessions. Potential losses are estimated to be approximately $420,000, due to reduced parking and shuttle use.

In a wet year, the 5,000 cfs flow at the end of July would inundate portions of the Boise River Greenbelt, disrupting high summer-time use of the Greenbelt. Based on total annual use estimates for the Boise River, an estimated 175,000 recreation-days of use could be lost under Alternative B. Impacts of Alternative B in wet and average years would be the same as for Alternative A with wet water year conditions.

Anderson Ranch Reservoir

Recreation impacts of Alternative B would be nearly the same as for Alternative A.

South Fork Boise River

Under Alternative B flows of the South Fork Boise River would be substantially higher (up to 2,100 cfs compared to 300 cfs) in September. Depending on weather, boating and rafting activity could be greater than normal and greater than Alternative A.

Mitigation and Residual Effects

Reclamation would conduct a public information and outreach effort (similar to Alternative A) which would notify recreationists in advance of operational changes needed for construction.

Drawdown of Lucky Peak Lake prior to Labor Day would result in unmitigated, residual impacts to some recreationists due to increased boating congestion and conflicts brought about by reduced lake surface at the end of July. Some boaters may choose to boat elsewhere, possibly Anderson Ranch Reservoir or Lake Lowell. However, there is no other reservoir within 8 miles of the Boise metropolitan area, providing opportunities for 'after-work' flat-water recreation. Given the question of suitable substitute sites, up to 103,100 recreation-days may be lost due to the third construction season under Alternative B.

Some flooding of the Boise River Greenbelt and float-boating impacts on the Lower Boise River in wet water years could not be mitigated. The primary use stems from Boise. It is unlikely that users could find adequate substitute floating opportunities similar to the Boise River. The loss of recreation opportunities is estimated at 175,000 recreation-days of use.

Residual impacts would be short term, lasting only through the construction period. Thereafter, reservoir operations would return to normal.

Economics

Affected Environment

Arrowrock Reservoir is located primarily in Elmore County while lands receiving irrigation water from the reservoir are located, with a small exception, in Ada and Canyon Counties. Boise, at over 157,000 population (U.S. Department of Commerce, 1998), is the largest city in Ada County, the largest city in Idaho, and the state capital. The location of the three counties in southwestern Idaho is shown in figure 3-2.

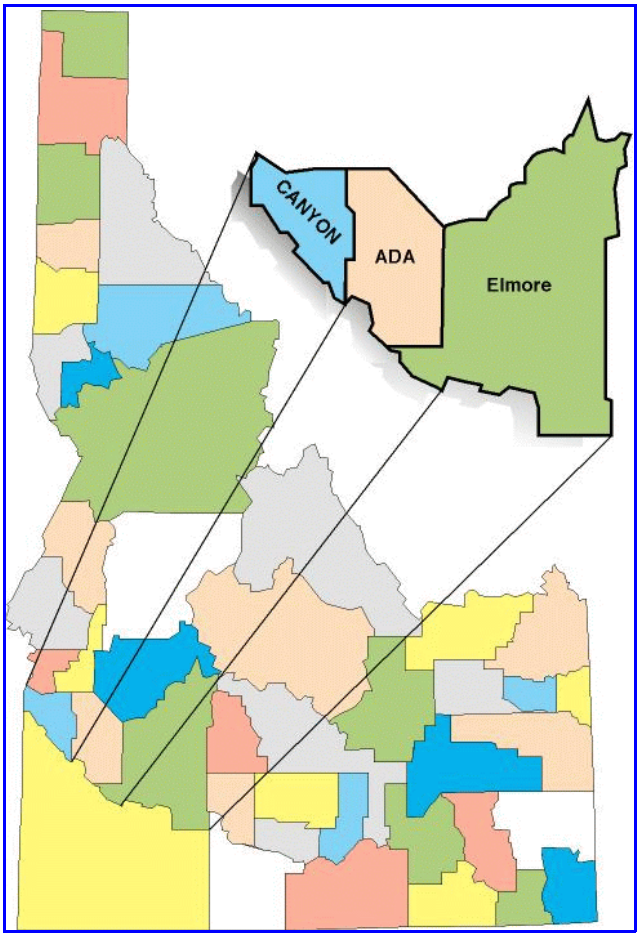

Figure 3-2. Idaho Counties

Population and Income

The 1998 population of the three counties was estimated at 421,367, an increase of 106,979 over 1990. This 33 percent increase reflects an annual growth rate of 3.7 percent per year. Nearly one-third of the population of Idaho live in Ada and Canyon Counties.

Personal income in 1998 was $11.0 billion for the three counties; a per capita income of $26,113, which is 118 percent of that for Idaho ($22,079). Table 3-21 summarizes population and personal income statistics. Population and Income are summarized in table 3-30.

Table 3-30. 1998 Population and Income

Area	Population (Estimated)	Personal Income	
		Total	Per Capita
Ada County	275,623	$8,332,090,000	$30,230
Canyon County	120,385	$2,146,850,000	$17,833
Elmore County	25,359	$524,407,000	$20,679
Total	421,367	$11,003,347,000	$26,113
State of Idaho	1,230,923	$27,177,357,000	$22,079

Source: US Department of Commerce, Bureau of Economic Analysis. 1998. Regional Accounts Data, Local Area Personal Income, Website, file CA1-3, 2000

The major industries in the area are services (27.3 percent), retail trade (17 percent), manufacturing (13.9 percent), government (9.7 percent), and construction (7.8 percent). Economic base studies by the University of Idaho indicates that the agricultural industry accounted for 6.5 and 6.8 percent of the regional income and regional employment respectively in southwestern Idaho in 1993. Engel and Holland (1998) using more current time series support the University of Idaho findings. This latter study showed that including the backward and forward linkages to that produced at the farm level, irrigated agriculture accounted for 7.5 percent of the employment and 9.1 percent of the regional income in southwestern Idaho in 1994. Farms and agricultural services accounted for 4.1 percent of employment in 1996. Employment and income for farm and agriculturally related industries for the study area have declined relative to all employment and income. This is due to the higher growth rates in manufacturing (including technology related industries), services, and retail trade rather than an absolute decline in the output of farms and agriculturally related firms. Table 3-31 summarizes employment by industry for 1996.

Table 3-31. Employment by Sector (1996)				
Industry	Employment			
	Canyon	Ada	Elmore	Total
Farm	3,333	1,714	833	5,880
Agricultural services, forestry, fish, and other	2,102	2,413	270	4,785
Manufacturing	11,393	24,040	527	35,960
Mining	64	331	20	415
Construction	4,435	15,345	478	20,258
Transportation, communications, and public utilities.	2,469	8,226	323	11,018
Wholesale trade	2,146	9,979	157	12,282
Retail trade	8,929	33,196	1,824	43,949
Finance, insurance, & real estate	2,062	14,400	361	16,823
Services	13,679	55,422	1,604	70,705
Federal civilian	251	4,467	954	5,672
Federal military	533	1,293	3,930	5,756
State and local government	5,282	18,745	1,214	25,241
Total				258,744
Source: U.S. Bureau of Economic Analysis, State of Idaho Web page				

Agricultural Economy Information

Water accruing to the space in Arrowrock Reservoir (originally 286,600 acre-feet) is contracted by the United States to 10 irrigation districts located in the Boise Valley and to the USFS. These spaceholder contracts are a form of repayment contract that include an annual payment for the reimbursable costs of construction and for operation and maintenance. A spaceholder contract means that Reclamation sold each contractor (spaceholder) a share of the reservoir space, not a specific amount of water to be delivered each year. Five of the irrigation districts are organized as the Boise Project Board of Control. Table 3-32 summarizes irrigation entities and contracted space.

Table 3-32. Arrowrock Reservoir Spaceholder Contracts	
Entity	**Contracted Space (Acre-Feet)**
Boise Project Board of Control[1]	232,264
Big Bend Irrigation District	236
Boise-Kuna Irrigation District	6,747
Nampa & Meridian Irrigation District	5,584
New York Irrigation District	2,414
Wilder Irrigation District	7,819
Ridenbaugh Canal (Nampa & Meridian Irrigation District)	3,994
Farmers Union Ditch Company	2,926
Farmers Cooperative Ditch Company	1,207
Pioneer Irrigation District	21,399
Settlers Irrigation District	1,810
U.S. Forest Service	200
Total	286,600
[1]Consists of the New York, Nampa & Meridian, Boise-Kuna, Wilder, and Big Bend Irrigation Districts. Each of these entities also have separate contracts for space.	

Irrigation water from Arrowrock Reservoir is applied to approximately 237,000 acres in Ada and Canyon Counties in Idaho and to a small acreage in eastern Malheur County in Oregon (Big Bend Irrigation District). For the most part, these irrigation districts combine storage water from Arrowrock Reservoir with water held under Reclamation storage contracts in Anderson Ranch Reservoir and/or Lucky Peak Lake, natural flows (rivers), and ground water (wells).

Ada and Canyon Counties contain highly productive lands, much of which have been irrigated since the early 1900's. The 1997 *Census of Agriculture* (Department of Agriculture, 1997) reports 3,119 farms in Ada and Canyon Counties with total farm sales of $405 million, including $192.8 million in crop sales; this amounts to approximately $130,000 per farm. Irrigated farms totaled 2,744 (88 percent of all farms in the area) with a total of 479,002 acres of which 299,163 acres were under irrigation, including 257,132 acres of harvested cropland.

Irrigation in both counties includes numerous small and part-time farms and an increasing number of suburban living arrangements. For the two-county area, the Census reports that farms with sales of over $10,000 account for 45 percent of all farms, but account for 93 percent of all irrigated lands, and 99 percent of all farm sales. Table 3-33 summarizes farm data from the 1997 Census of Agriculture.

Table 3-33. 1997 Census of Agriculture Data by County			
Item	**Ada**	**Canyon**	**Total**
Farms (number)	1,221	1,898	3,119
Land in irrigated farms (acres)[1]	195,895	283,107	479,002
Irrigated land (acres)	78,112	221,051	299,163
All farms with sales of $10,000 or more [2]			
Farms (numbers)	413	979	1,392
Land (acres)	201,791	280,492	482,283
[1]Include all land (irrigated and non-irrigated) in farms with irrigation. [2]Includes farms that have no irrigated land.			

Hydropower

There are two small private powerplants currently operating within the Boise River system. One of the small private hydroelectric powerplants (150 kW) is located on the Middle Fork near the town of Atlanta, and the other is a 4,500 kW-powerplant located at Barber Dam. In addition, Reclamation's 1,500-kW powerplant at Boise River Diversion Dam was placed in a ready reserve status in 1983 and has not been operated since that time. None of these small powerplants would be affected by any of the alternatives. However, there are two larger hydroelectric powerplants that would be affected by the alternatives, Anderson Ranch Powerplant, and Lucky Peak Powerplant.

Anderson Ranch Powerplant at Anderson Ranch Dam is a Federal facility constructed and operated by Reclamation. This powerplant has a 40-MW capacity and consists of two 20-MW units. The average annual generation was 153,561,536 kWh for the 5-year period of 1994-1998 and 120,893,108 kWh for the 10-year period of 1989-1998. The lower annual average generation for the 10-year period reflects several drought years in the early 1990's.

Electrical power generated at most Reclamation powerplants in southern Idaho is used for project irrigation pumping. Generation in excess of that needed for project pumping is delivered to the Bonneville Power Administration (BPA) for marketing to various customer classes. Project pumping does not include onfarm pumping which is the responsibility of individual farmers who generally purchase electric power from local utilities.

Lucky Peak Powerplant at Lucky Peak Dam is owned by four irrigation districts of the Boise Project Board of Control. Seattle City Light, under contract to the powerplant owners, currently operates the powerplant and purchases the output. Lucky Peak Powerplant has an operating capacity of 101 megawatt (MW) and consists of two 45-MW units and one 11-MW unit. Average annual generation is approximately 350,000,000 kilowatt-hours (kWh).

Environmental Consequences

Economic impacts were identified for irrigated agriculture, hydropower generation, and recreation. Short-term and long-term impacts were distinguished. Short-term impacts are those impacts expected to occur in a 4-year impact period. Long-term impacts are those impacts expected to occur after construction is completed and normal reservoir system operations are resumed. All identified impacts are direct impacts; indirect impacts were not identified.

Unless otherwise indicated, impacts in this section are presented as the difference between the No Action effect and an action alternative. Direct impacts were evaluated using criteria contained in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (Water Resource Council, 1983).

The foundation for estimating economic impacts is the hydrologic modeling of the water supply and streamflows that determine changes in agricultural output, hydropower generation, and recreation use of the reservoirs and rivers. The hydrologic modeling is a probabilistic study of the water supply for the period of record 1961-1998.

All of the economic analysis is derived directly from the wet, average, and dry 4-year sequences identified in the hydrology studies. For the power analysis, monthly hydrology data on reservoir levels and streamflows are used. For recreation, frequency of reservoir levels and river flow volumes were developed and compared against recreation use parameters and thresholds at sites to estimate the change in user activity.

Agriculture

Impact Indicators and Methods of Evaluation

Water shortage is the primary impact indicator for irrigated agriculture. Monetary values can be derived by calculating the value per acre-foot of water based on crop production and then applying this value to water shortages. For this analysis, impacts of water supply on irrigation are based on delivery shortages to the canal systems in the Boise Valley downstream from Arrowrock to Middleton, Idaho.

These shortages can then be applied to the value of the water to crop production. The reported average crop receipt per acre for 1990-92 (last available data) for the Arrowrock Division of the Boise Project is $563 per acre. This is equivalent to $154 per acre-foot of water at the farm. More recent work prepared by Reclamation estimates a gross crop receipt of $700 per acre utilizing current yields, commodity prices, and cropping patterns. This is equivalent to $200 per acre-foot of water. These figures provide a range estimate for the value of water.

Shortages are measured at the point of supply, i.e., at the reservoir or river diversion, and estimates of crop sales per acre-foot of water are measured at the onfarm diversion point. As a result a conversion factor is needed. For this study, the water supply available at diversions points was reduced by 40 percent to represent transportation and distribution losses between the diversion and the onfarm delivery.

Irrigation Shortages

The analysis of shortages assumes that all shortages associated with the alternatives would be borne by the Arrowrock Reservoir spaceholders, i.e. these shortages would not be shared among Anderson Ranch Reservoir and Lucky Peak Lake spaceholders. The 4-year analysis period includes the irrigation season following the maintenance drawdown (for the No Action Alternative) and the third construction season for the action alternatives. Probability of reservoir refill was not calculated because irrigation shortages provide a more direct estimate of effects to spaceholders.

Total shortages during the wet (1980-1983) and average (1961-1964) 4-year sequences would not generally be significant with any alternative; more substantial shortages would occur for all alternatives with the dry (1988-1991) 4-year sequence. Table 3-34 summarizes the cumulative irrigation shortages that would be expected with 4-year periods selected to represent wet, average, and dry sequences. For reference, total annual diversions without construction or maintenance are estimated at 1,300,00 acre-feet in a wet year; 1,550,000 in an average water year, and 804,000 acre-feet in a dry year.

Table 3-34. Irrigation Shortages Over a 4-year Sequence (Acre-Feet)

Alternative	Wet Sequence	Average Sequence	Dry Sequence
No Action	65,200	121,600	550,100
Alternative A	0	55,000	478,700
Alternative B	0	0	403,300
Shortage specific to Maintenance/Construction drawdowns			
Alternative A	0	55,000	81,000
Alternative B	0	0	5,600

Because of the size of shortages in a dry period, shortages by year for the 4-year dry sequence of 1988-1991 were analyzed. Compared to the total period of record (1961-1998), 1991 was the 5th driest year, 1988 was the 6th driest year, 1990 was the 8th driest year, and 1989 ranked 17th driest year. Of all the 4-year sequences, only 11 to 17 percent, depending on the alternative, would have the same or less water supply than the 1988-1991 period. Table 3-35 shows that most of the 4-year shortage in a dry sequence would occur in the Year 3, the irrigation season that follows the third construction season.

Table 3-35. Irrigation Shortages for a 4-Year Dry Period (1988-1991) (Acre-Feet)					
Alternatives	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Total**
No Action Alternative	0	64,000	149,700	[2]336,400	550,100
Alternative A	0	0	143,600	335,100	478,700
Alternative B	0	0	135,200	268,100	403,300
Incremental Change, Alternative Compared to No Action[1]					
Alternative A	0	-64,000	-6,100	-1,300	-71,400
Alternative B	0	-64,000	-14,500	-68,300	-146,800
Shortages Due Specifically to Construction					
Alternative A	0	0	55,000	26,000	81,000
Alternative B	0	0	46,600	41,000	5,600

[1]Negative values indicate less shortage (more water supply) than the No Action Alternative.
[2]No Action shortages could occur every sixth year.

No Action Alternative

Irrigation shortages would occur under all three 4-year sequences and would be greater for No Action than for Alternative A and B. The cumulative 4-year irrigation shortage in a dry year scenario with No Action is estimated at 550,000 acre-feet, and 61 percent of that would occur in the fourth year.

Under No Action, irrigation deliveries would continue to be potentially impacted every sixth year when Arrowrock Reservoir is drawn down for maintenance. The periodic drawdown would create uncertainty for subsequent year reservoir refill due to potentially lost reservoir storage from drawdown combined with the shorter refill period.

Alternative A (Preferred Alternative)

Alternative A would have no shortages during a wet sequence, 55,000 acre-feet of shortages for the average sequence, and 480,000 acre-feet of shortages in a dry sequence; about 70 percent of the dry sequence shortage would be in the fourth year.

Alternative A shortages would be less than for No Action, but fourth year shortages in a dry period would be nearly the same.

Alternative B

There would be no irrigation shortages under Alternative B in a wet or average sequence. In a dry sequence, Alternative B 4-year cumulative shortages would be about 400,000 acre-feet with 66 percent of that occurring in the fourth year.

Shortages with Alternative B would be less than for No Action and Alternative A. In a dry sequence, Alternative B shortages would be nearly 68,000 acre-feet less in the third year than for No Action and Alternative A.

Economic Impacts to Spaceholders

A comparison of probable shortages to normal irrigation diversions provides a perspective on potential impacts. Annual diversions based on the hydrologic model for the recent 10 year period of record 1989-1997 average about 1.3 million acre-feet and range from 804,000 acre-feet in a dry year (1992) to1,550,000 acre-feet in a wet year (1997). Based on the range of gross crop income values, total gross crop income generated by the 1.3 million acre-feet of diversions in an average year (1989-1997) would range from $120 to $156 million annually. Crop receipts in the Boise Valley are more influenced by yields and crop prices than by water supply.

Irrigators have some flexibility in managing water use by switching to crops with a lower water requirement, but only if the water situation is known sufficiently in advance. Otherwise, the only option is to include deficit irrigation of certain crop types or idle farmland in that year. Fruit trees, vines, and certain perennial (forages and pasture) crops cannot be readily added or deleted from a crop rotation. However, these crops have some potential for deficit irrigation, yet remain alive. Row crops and grains have the most potential for adjustment. Some crops like potatoes, alfalfa seed, corn seed, and others are grown under contract. It is unknown to what extent that the reduction or cutback in acreage would complicate securing contracts in subsequent years.

In a dry period, whether it be cropping changes, deficit irrigation, or idling farmland, crop receipts would be reduced. However, past experience indicates that given the relative amount of irrigation diversions in the basin model (1.3 million acre-feet) shortages of 50,000 to 75,000 acre-feet per year or greater, can in reality, be accommodated in actual system operations.

There are no short-term incremental adverse economic impacts for Alternative A and B since the shortages under Alternatives A and B would be less than under No Action. In fact, shortages would be only 4.2 percent of average diversions, so it is likely that any impact would be negligible. As a result, potential monetary impacts were not analyzed for this analysis.

Over the long-term Alternatives A and B would have a slight beneficial impact compared to No Action because no future drawdowns would be required.

Financial Impacts to Arrowrock Spaceholders

Spaceholders of Arrowrock Reservoir would continue to pay 46 percent of the annual OM&R costs for Arrowrock Dam and Reservoir under all alternatives. The remaining 54 percent of costs is allocated to flood control, recreation, and fish & wildlife and is returnable from the United States Treasury through annual appropriations. As a benchmark, the spaceholders (irrigators) paid an average of $197,400 per year for 1996-1998.

No Action Alternative

Under the No Action Alternative, an estimated $34 million would be required to repair and/or replace the existing sluice and outlet gates in-kind. The annual OM&R costs could be expected to escalate in future years.

Alternatives A (Preferred Alternative) and Alternative B

The estimated cost for Alternatives A and B is $15 million and $14.6 million respectively. Accordingly, $6.9 million and $6.7 million (46 percent) respectively would be payable by the 11 entities who hold storage rights in Arrowrock Reservoir. Table 1 in Appendix J shows the distribution of the estimated $6.9 million (Alternative A), the District acreage served, and the resulting investment cost per acre for each entity. Because the irrigation districts hold different proportions of their total irrigation supply in Arrowrock Reservoir and also have different acreages, the estimated total reimbursable cost varies from approximately $2 to $37 per acre. As a point of reference, Arrowrock spaceholders paid an average of $226,200 per year for Arrowrock assessments for the period 1996-1999, or an average of $.87 per acre. In 1999 the average Arrowrock assessment was $2.13 per acre.

Reclamation law and policy require repayment in advance of the work to be performed. It is estimated that construction, including planning and design, will be completed during a 5-year period, calendar year 2000 through 2004, but with the bulk of the work taking place in 2001, 2002, and 2003. Accordingly, assuming construction disbursements are in the same year as construction activities, the irrigation districts will repay the obligation over the 5-year period.

Table 2 in Appendix J identifies each district's estimated repayment obligation based on the estimated construction schedule. For reference purposes, the table also shows the reimbursable cost per acre for each year of construction, as well as the historical 4-year average Arrowrock assessment for the period of 1996 through 1999, the period just prior to Arrowrock outlet rehabilitation.

The financial obligation of each district will be passed on to individual members in the district in the form of increased assessments during the construction period. In some cases, however, districts have increased their current assessments to build a reserve fund. District assessments normally include all the cost of district operations, including operation and maintenance of district operated conveyance and delivery facilities, debt service, management, water purchases/rentals, as well as obligations to the United States for the proportionate share of cost to operate and maintain Arrowrock Dam. Some of the Arrowrock districts also have storage in Lucky Peak and Anderson Ranch, with accompanying assessments for those facilities.

The total reimbursable cost for the proposed Arrowrock rehabilitation ranges from approximately $2 to $37 per acre. On an individual year basis the highest obligation ranges from approximately $0.70 to $13 per acre in both years 2 and 3 (or 2001 and 2002). Although the advance notice will assist individual irrigators by allowing time to plan for the assessment increase, the assessments will probably not trigger any significant change in cropping or management practices. Table 3 in Appendix J lists farm operating cost, cash ownership cost, and non-cash ownership costs

developed by the Cooperative Extension Service, University of Idaho for the major crops grown in the irrigation service areas. Relative to the magnitude of the production costs for the crops shown in the table, the assessment increases are not exceptionally large.

Any potential impact of the $6.9 million in reimbursable cost to southwest Idaho must be evaluated not only at the farm level but should also recognize the impact to industries that are linked backwards and forwards to on-farm crop and livestock production. Backward linkages include the purchase by farmers of farm production items (seed, fertilizer, chemicals, etc.), while forward linkages include the processing of farm products, and the transportation of those processed products. These linkages enhance the economic output (income and employment) over that of the direct impact at the farm level. According to the 1997 Census of Agriculture, farms in Ada and Canyon counties had crop sales of $192.8 million and livestock and livestock product sales of $311.4 million in 1997. As a reference point for the $6.9 million, the 1997 Census estimated farm production expense at $330.8 million in 1997 for the two county area.

In summary, given the relative obligation ($6.9 million) relative to total farm production expense, the size of the agricultural economy in southwestern Idaho, as relative to the total economy in southwestern Idaho it is unlikely the repayment of $6.9 million for Arrowrock will, by itself, have a significant impact on the economy of the Treasure Valley. Individual producers may cut back or postpone purchases of some productions items, like new machinery investments. Unless lands are taken out of production or significant changes are made in cropping, the flow of farm products to farm processors is expected to remain relatively constant.

The cost estimate of Alternative A and B are $19 million and $19.4 million less respectively than the cost for No Action. Although the costs of Alternative A or Alternative B are lower, they would be expended over a short period compared to No Action.

Over the long term, annual OM&R costs for Arrowrock Dam and Reservoir under Alternative A or Alternative B would be slightly less compared to the No Action Alternative.

Recreation

Impact Indicators/ Methods of Evaluation

This section identifies the direct economic impacts on recreation activities at reservoirs and river reaches during the construction period for the outlet gate rehabilitation project at Arrowrock Dam. Direct economic impacts were quantified only for Lucky Peak Reservoir and the Lower Boise River (downstream of Lucky Peak Dam). Economic impacts at Anderson Ranch Reservoir, the South Fork of the Boise River downstream of Anderson Ranch to the confluence with Arrowrock Reservoir, and at Arrowrock Reservoir were not evaluated quantitatively because the impacts were estimated as insignificant or non-existent. The recreation resource section discusses the changes in recreation use at the various sites with the alternatives.

Impacts were measured as the change (reduction) in recreation use because of limited access to facilities or unsuitable river flows resulting from changes in operations of the reservoir/river system during construction. Changes were measured as the reduction in use compared against a

normal operations (neither maintenance nor construction) including access. Changes in use for specific activities were monetized at user-day values that were developed by Reclamation (1999) for the Corps study titled *Lower Snake River Juvenile Salmon Migration Feasibility Study and Environmental Impact Statement*. The unit-day values were developed for the Snake River basin, including the Boise River, using the criteria from the Water Resource Council's *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (Water Resource Council, 1983). These unit-day values are considered appropriate for this analysis.

The unit-day values multiplied by the change in user-days reflect the direct impacts using National Economic Development (NED) criteria. The recreation resource section discusses the loss of potential sales revenue to entities that provide recreation services. These potential loss revenues would accrue to recreation service providers and vendors resulting from a loss of sales for services such as boat slips, use fees, parking, etc. These potential revenue losses are not an NED impact and were not included in the analysis.

No Action

Under the No Action, Alternative Arrowrock Reservoir would continue to be subject to periodic drawdown (6 year cycle) for inspection and maintenance of the sluice gates and Ensign valves. These periodic drawdowns would be, for the most part, late in the recreation season and during the fall. Lucky Peak would also be drawn down at times during the late season during those periodic years in which Arrowrock is inspected and maintenance performed..

Alternative A (Preferred Alternative)

Impact losses to river floating on the Lower Boise River (below Lucky Peak) in an average year were estimated at $314,100 during the construction period (43,750 days lost x $7.18). During a wet year, the river floating season would be even shorter, because of high flows, with the loss estimated at $1,256,500 during the construction season (175,000 days lost x $7.18).

Under Alternative A, potential impacts to visitor days at Arrowrock Reservoir, Lucky Peak Lake, Anderson Ranch Reservoir, and the South Fork of the Boise River downstream of Anderson Ranch Dam were considered too variable to quantify; however, they are thought to be relatively small given their late season timing. Some secondary financial impacts may occur to providers of recreation services as a result of the project.

Alternative B

Impact losses to river floating on the Lower Boise River (downstream of Lucky Peak) were estimated at $1,256,500 during the construction period (175,000 days lost x $7.18). Total impact losses at Lucky Peak were estimated at $3,702,900 and include fishing, swimming, water skiing, and boating as shown in table 3-36.

Table 3-36. Alternative B, Economic Impacts at Lucky Peak Lake			
Activity	**Days Lost**	**Value Per Day**	**Benefit Lost**
Fishing	20,145	$27.01	$544,100
Swimming	26,070	$23.58	$614,700
Water skiing	16,590	$44.73	$742,100
Boating	40,290	$44.73	$1,802,000
Total	103,095	n/a	$3,702,900

Under Alternative B impacts at Anderson Ranch Reservoir, South Fork of the Boise River below Anderson Ranch Dam, and at Arrowrock Reservoir were considered non-existent or too small to quantify.

Recreation Economics Summary

NED Recreation impacts by alternative and river reach are summarized in table 3-37.

Table 3-37. Direct Recreation Impacts During Construction			
River Reach	**No Action**	**Alternative A**	**Alternative B**
Arrowrock Reservoir	Very minor negative impact in late season compared to normal conditions.	Slight positive impact in construction seasons 1 and 2 of an average or wet year. Slight negative impact in construction season 3 late in recreation season.	Slight positive impact in construction season 1 and 2. Slight negative impact in construction season 3 in late season..
Lucky Peak Lake	Minimal negative impact compared to normal operating conditions during maintenance years. Boat slips out of water 1week earlier than under normal operations during those years.	Minimal negative impact compared to normal operating conditions due to boat slips out of water 1week earlier than under normal operations.	Significant benefit loss of $3,702,900 due to reduced access to facilities.
Lower Boise River	No effect under average water conditions. Negative effect (high river flows) during wet years	Benefit loss of $314,100 in average or dry year due to loss of river floating, – high river flows. Benefit loss of $1,256,500 in wet year. Due to loss of river floating – high river flows.	Benefit loss of $1,256,500 in construction season 3 in average and wet years. Due to loss of river floating – high river flows for a longer period than Alt. A.
Anderson Ranch Reservoir	Positive impact to late season recreation use compared to normal operations due to higher reservoir elevation.	Positive impact to late season recreation use compared to normal operations due to higher reservoir elevation.	Positive impact to late season recreation use compared to normal operations due to higher reservoir elevation.
South Fork Boise River	No change from normal operating conditions.	No change from normal operating conditions.	No change from normal operating conditions.

Hydropower

Impact Indicators/Methods of Evaluation

Monthly and annual totals of energy generation are the primary impact indicators for hydropower generation. Monetary values are calculated by applying the cost of buying an equivalent amount of power from a pool of available resources. Monthly power production at Anderson Ranch and Lucky Peak powerplants was estimated for each alternative using the **MODSIM** based hydrology model for the Boise River. Average monthly generation for the period of record (1961-1999) was used in this analysis.

The value of any energy change was calculated by applying monthly marginal cost values developed by BPA for 1999-2000 (BPA,1999). These values are the current cost, in 2001 nominal dollars, of replacing equivalent energy from the stack of available system resources. Values were weighted 57 and 43 percent respectively for heavy and light load hours.

The market price for electricity, including recent increases in natural gas prices, in the Pacific Northwest has rapidly changed in the past months. Because of this, the value of generation changes is shown as a range, expressed as a low and high value. The low value utilizes BPA information prepared for the 2002 Initial Power Rate Proposal. The high value utilizes more recent preliminary values developed by BPA as an adjunct to the initial study and reflects the more current situation in power markets in the Pacific Northwest and the nation as well. Only time will tell whether these conditions will prevail over the long term.

Monthly values range from $16.10 per megawatt-hour (MWh) in May to $33.60 per MWh in August for the low value, and from $24.73 per MWh to $71.14 per MWh for the same months for the high. Differences in monthly values reflect the seasonal marginal cost for energy in the Pacific Northwest. These values were applied to the incremental changes in generation for the action alternatives compared to the No Action. As applied in this analysis the resulting economic value represents the cost or benefit of equivalent energy. The monthly marginal cost values are summarized in table 3-38.

Table 3-38. Marginal Cost of Power by Month in Pacific Northwest (Dollars per MWh)		
Month	**Low Value**	**High Value**
January	30.40	41.47
February	29.30	36.09
March	27.70	32.98
April	18.70	27.35
May	16.10	24.73
June	20.40	29.69
July	29.00	52.25
August	33.60	71.14
September	33.00	52.95
October	26.80	36.63
November	31.50	44.01
December	32.40	43.59
Average	27.41	44.01

Generation

Hydropower generation derived from the modeling is shown for Anderson Ranch Powerplant and Lucky Peak Powerplant in table 3-39.

Table 3-39. Hydropower Generation, Over a 4-Year Impact Period (MWh)[1]			
Alternative	**Anderson Ranch**	**Lucky Peak**	**Total**
No Action Alternative	510,661.4	1,261,924.3	1,772,585.7
Alternative A	521,845.5	1,227,796.5	1,749,642.0
Alternative B	520,817.5	1,223,197.8	1,744,015.3
Increment over No Action			
Alternative A	11,184.1	-34,127.8	-22,943.7
Alternative B	10,156.1	-38,726.5	-28,570.4
[1] Sum of monthly generation over 4-year period (48 values)			

Figures 3-3 and 3-4 summarize average monthly generation during the 4-year construction-impact period.

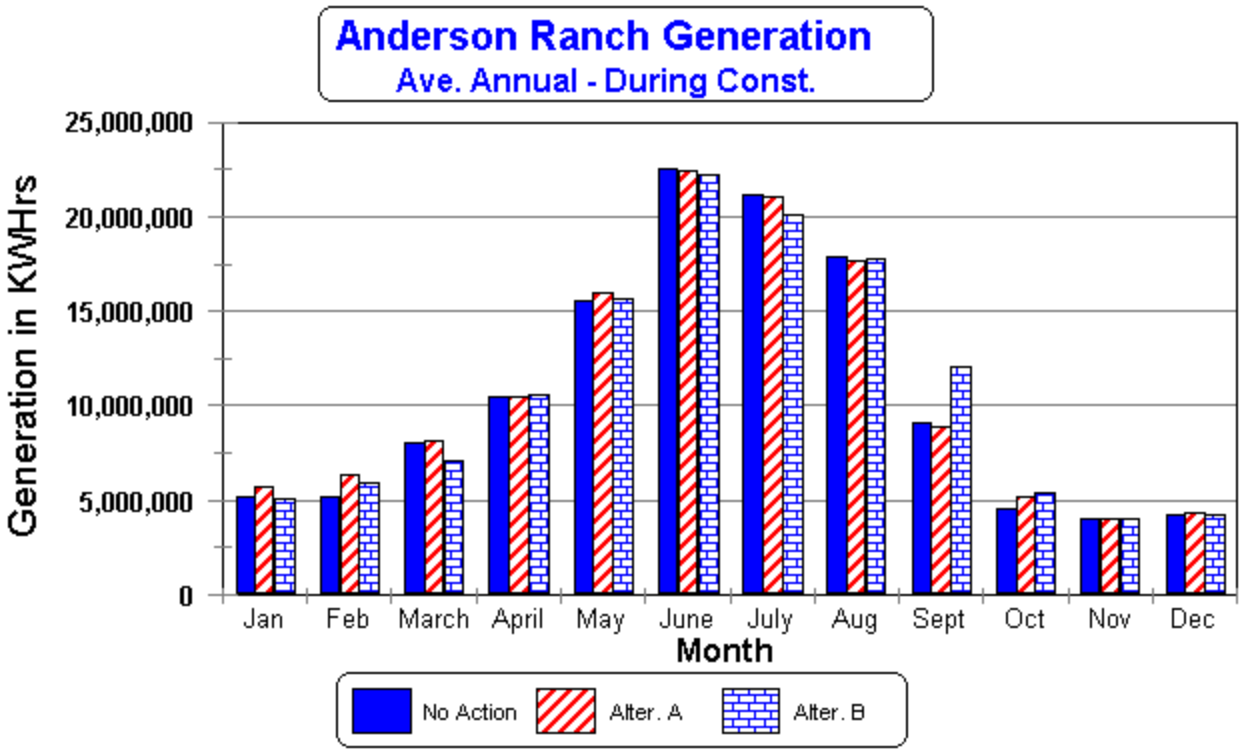

Figure 3-3. Average Monthly Generation at Anderson Ranch Powerplant for a 4-Year Impact Period

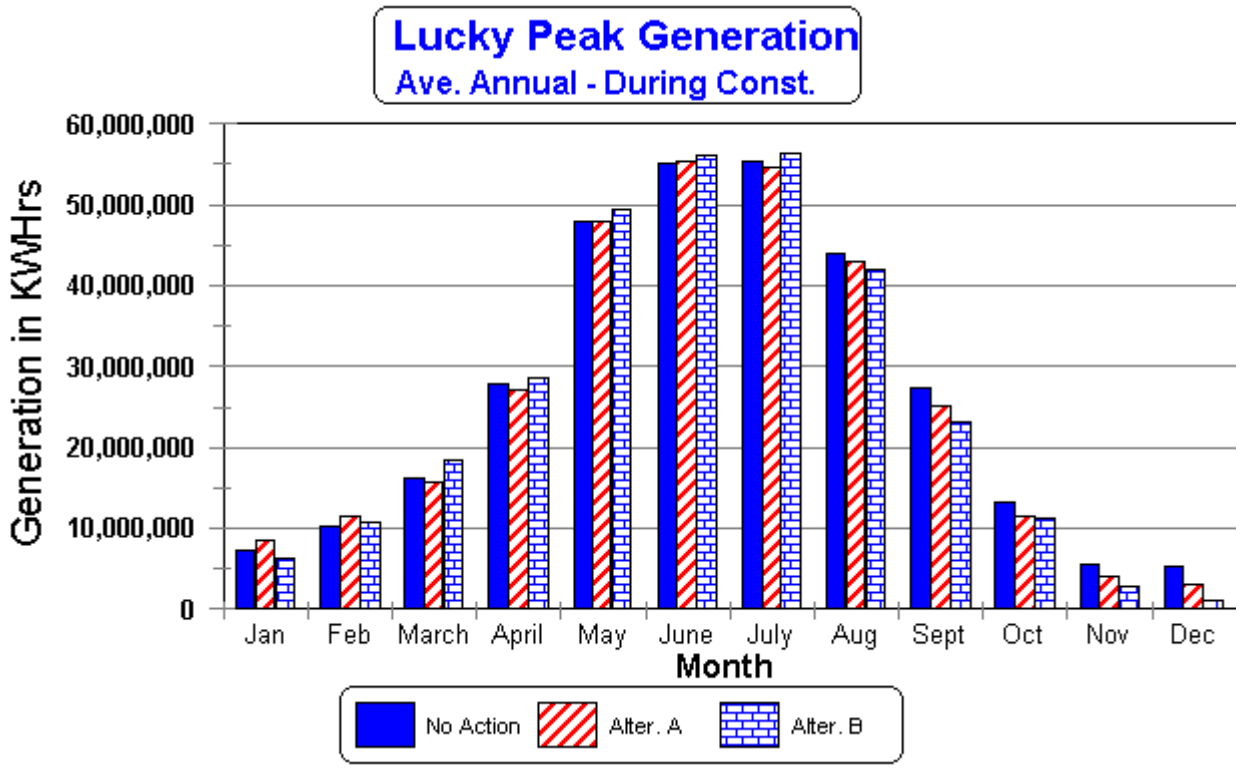

Figure 3-4. Average Monthly Generation at Lucky Peak Powerplant for a 4-Year Impact Period

No Action Alternative

Under No Action, generation at Lucky Peak and Anderson Ranch Powerplants would total about 1,772,600 MWh over the 4-year impact period. For the last 10 years the average generation over a 4-year period has been 1,819,000 MWh.

Alternative A (Preferred Alternative) and Alternative B

Under Alternatives A and B, generation at Lucky Peak and Anderson Ranch would total 1,749,600 MWh and 1,744,000 MWh respectively over the 4 year impact period. These are reductions of 22,900 MWh and 28,600 MWh (1.27 percent and 1.61 percent) respectively for Alternative A and Alternative B compared to No Action.

The decreased value of power generation for the 4-year impact period would range from $740,000 to $1,285,000 for Alternative A and from $1,115,000 to $1,786,000 for Alternative B. These values reflect an increase in at Anderson Ranch Powerplant which is more than offset by a decrease at Lucky Peak Powerplant. Table 3-40 summarizes the economic impacts on power production.

Table 3-40. Value of Incremental Generation Change Compared to No Action

Alternative	Anderson Ranch	Lucky Peak	Total[1]
Alternative A			
Low value	$290,700	-$1,030,700	-$740,000
High value	$355,100	-$1,640,200	-$1,285,100
Alternative B			
Low value	$331,500	-$1,446,900	-$1,115,400
High value	$489,500	-$2,275,800	-$1,786,300

[1]Value based on current replacement cost. The value of energy at Lucky Peak Powerplant may be measured at a higher or lower value by Seattle City Light, the purchaser of plant output.

Long-term effects on power generation were compared to historical production. That analysis indicates that after the outlet valves are replaced, generation at both powerplants would return to that under normal conditions. This qualitative analysis was made to insure that the outlet valve replacement would not reduce or otherwise hinder power operations. Long-term impacts were not monetized, but over the project life the impact of Alternative A or B would be positive compared to the No Action Alternative.

Mitigation and Residual Effects

No mitigation was identified for any of the economic impacts associated with agricultural production and hydropower generation. Economic impacts would be temporary, short-term impacts and all impacts would be residual effects.

Although Reclamation was unable to precisely quantify recreation impacts, we recognize that several agencies have concerns about potential recreation economic impacts as a result of the project. Reclamation will work with Idaho State Parks and Ada County within the limits of its authorities to offset critical economic losses, if any, during the 3-year construction period. Funds will also be allocated for additional law enforcement and safety support consistent with conditions and need. There still would potentially be residual economic effects as Reclamation assistance would not completely compensate for economic losses.

Cultural Resources

Affected Environment

Overview

In southwestern Idaho, human use of the Snake River region and its tributaries was one of increasing complexity in settlement and subsistence procurement processes through time–from highly nomadic groups of big-game hunters during the Paleoindian Period to small groups of foragers operating from more permanent base locations by the Late Archaic Period and into historic times. As a crucial water source and as the locus of abundant plant and animal resources and more sheltered winter habitation sites, the Snake River and its tributaries drew people to their banks. The importance of fishing and riparian resources is one characteristic that links the prehistoric inhabitants of the Snake River region throughout time.

At the time of European incursion into southwest Idaho, the Snake River Shoshone (represented by Shoshone and Bannock peoples) and Northern Paiute groups occupied the Boise River and the Payette River basins (Steward 1938, Liljeblad 1972, Walker 1978). Both populations utilized the lower Snake River area, while the latter group exclusively resided throughout middle and upper drainages. Early explorers reported the Boise River and vicinity was also an important seasonal rendezvous and trading place for nonresident groups from the Columbia river, northern Idaho, the Oregon deserts, and Wyoming.

The traditional subsistence system in use by the early 1800's was based on the meticulous exploitation of numerous plant, animal, and raw material resources obtained by traveling from one place to another in a seasonal round. Depending on local conditions, roots or seed plants provided a large portion of the food supply, although fish and small game were very important. Typically, multiple family groups spent the winter in small villages along the lower and middle reaches of the Payette and Boise Rivers. By early spring, stored food reserves were exhausted, and individual families spread across the landscape to forage. Through the late spring and summer they traveled throughout riverine and upland areas to harvest a wide range of seasonally available food, medicinal plants, and raw materials to manufacture tools and other essentials. In the fall they again converged on the rivers to exploit the fall salmon run. However, this traditional subsistence system was already changing when the first Europeans arrived.

The first long-term non-Indian occupants in southwest Idaho were fur traders. In 1813, a trading post was established near the mouth of the Boise River, and by 1818 the famous "Snake-Brigade" was operating from the Boise River to Yellowstone Park. Declining fur-bearing animal populations and a drop in beaver prices essentially ended the fur trade by 1840. However, soon afterward Americans traveling west on the Oregon Trail began to travel through southern Idaho. The discovery of commercially profitable amounts of gold in Grimes Creek in 1862 spurred permanent American settlement in southwest Idaho. The boom was instant but short-lived, as the easily mined placers were soon exhausted. However, it stimulated development of agricultural communities that flourished along the rivers in the Boise, Payette, and Weiser Valleys. Boise City was established in 1863, and other smaller towns soon sprang up. A second agricultural

boom occurred with the completion of the Oregon Short Line Railroad through southern Idaho in 1883; access to regional markets caused an influx of new settlers who wished to farm the fertile benchlands below Boise and Emmett.

The rapid settlement of southwest Idaho after 1863 had catastrophic impacts upon resident Indian populations. Lands in the lower valleys, where the native populations were densest, were settled and closed to the Indians, and miners and grazers penetrated into upland areas. Friction rapidly developed between the resident Indians and newly arrived settlers, leading to raids from both sides. Fort Boise was established by the Army in 1863 to protect settlers from Shoshone raids. The native culture quickly disintegrated under the agricultural developments that destroyed their lowland plant food base, denial of access to areas essential in the food collecting seasonal round, and the need to congregate for protection. In 1863, the Federal Government began to negotiate treaties to place the Shoshone and Paiute on reservations removed from their Boise and Payette Valley home-lands. A temporary Indian encampment was established on the Boise River at a location now within the Arrowrock Reservoir pool. It housed several hundred Boise Shoshone, Bruneau Shoshone, and Bannock Indians for several years during the 1860's before they were moved to permanent reservations. Ultimately, most of the southwest Idaho Indian populations were moved to the Fort Hall or the Duck Valley Indian Reservations.

As indicated above, after 1863 settlers flocked to the Boise Valley to establish farms and businesses. In arid Idaho, irrigation was essential for successful agriculture. By 1880, the seasonal water supply was insufficient to meet existing needs and prohibited expansion. After 1883, out-of-state investors attempted to build ambitious water systems, but most were at best only partially successful. Not until 1905, when the fledgling U.S. Reclamation Service was authorized to build the Payette-Boise Project, could the agricultural potential of the Boise and Payette drainages be fully realized.

Previous Investigations and Identified Cultural Resources

Limited archeological research has been completed in the Boise River Valley. No archeological investigations were undertaken before the impoundment of Arrowrock Reservoir in 1915. Surveys by the Smithsonian River Basin Surveys (Osborne, 1948) were the first professional investigations on the lower Boise River. Most surveys in the Arrowrock vicinity have been conducted over the last 20 years as “clearance” activities by the Boise National Forest or the Bureau of Land Management. Most of the surveyed areas are located along the river down-stream of Arrowrock Dam near the shores of Lucky Peak Reservoir. These surveys are generally reliable, although the absence of good maps makes some reports less useful.

There are no documented prehistoric archeological sites around the immediate perimeter of the reservoir above the high water line. Sites have been reported in surveys upstream of the reservoir (Murphy, 1979), and possible ground stone and obsidian flakes have been reported within a mile south of the reservoir (Clay et. al, 1977). Excavations at the Lydle Gulch site (10AA72), a stratified campsite below Lucky Peak Dam on the Boise River, shows the area to have been occupied intermittently during the past 4,500 years. Numerous projectile point types indicate the site was occupied by parties with close affinities to the Northern Great Basin and to a limited degree with the Columbia Plateau (Sappington, 1981). Other reported sites in the downstream

area include talus burials (Osborne, 1948); midden/quarry and toolmaking sites, and rockshelters (Ostrogorsky, 1976; Idaho Archaeological Survey, 1977); lithic scatters (Torgler, 1992); and petroglyphs (Harrison, 1986).

The Shoshone-Paiute have indicated that locations exist within the Arrowrock pool and vicinity that are important to them because of associations with their history and religion (Ted Howard and Terry Gibson, personal communication). The Shoshone- Bannock have indicated that there are places along the Snake River that still retain sufficient integrity to enable tribal members to conduct traditional ceremonial functions (Reclamation, 1995). These places continue to be of traditional cultural importance to both of the tribes. The locations and nature of these traditional cultural properties have not been specified. They may include areas that were once repeatedly visited to collect plant, animal, or fish resources important to the tribal economy; ceremonial locations important to physical and spiritual health and traditional religion; and places or landmarks associated with events important in tribal history or tradition. The historical or traditional value some of such sites would not be destroyed by the extreme alterations of the landscape caused by reservoir erosion or sediment deposition, and may continue to be used by the tribal members. The location of the 1860's encampment (site 10BO300) may have particular historical value to the Shoshone-Paiute and Shoshone-Bannock Tribes.

Historic sites of non-Indian origin recorded within a 10-mile radius of Arrowrock Reservoir include remnants of the Oregon Trail; placer mining sites (Fink, 1993); ditches, utensils, and a wooden flume (Murphy, 1979); sheepherder camps (Shaw, 1993); the archeological remnants of Foote House; and historic foundations and homestead and cistern (Ames et. al, 1977).

At least one historically documented archeological site is located within the reservoir pool–the 1860's temporary reservation mentioned above. The campsite is assumed to have encompassed a substantial area, since several hundred people lived there for several years. A smallpox epidemic is reported to have occurred at the camp, from which many perished (Terry Gibson, personal communication). Although the actual extent of the encampment area is not known, a possible camp locality has been recorded as site 10BO300. Ostragorsky reports locating an obsidian arrow point at that location (as noted in an Idaho Archaeological Survey site form dated 1977). All or portions of 10BO300 may be exposed during extreme low-water reservoir episodes.

Arrowrock Dam was listed in the National Register of Historic Places (National Register) in 1976 for its significance in engineering technological development and contribution to regional agricultural economic growth. The dam was one of the first concrete arch “high” dams built in the United States (briefly the highest in the world when completed in 1915) and was one location where Reclamation applied experimental design and construction technology. The Ensign valves may be the last set of such valves remaining in place in a dam. The 1915 truss bridge across the spillway is also eligible to the National Register.

When Arrowrock Dam was first constructed and when it was raised and repaired in 1932, a construction camp was built immediately below the damsite. It included administrative offices, construction facilities, and worker accommodations. Site 10BO303 is the remnant of the camp. Very little is left, as Reclamation removed all structures following completion of the dam, and high velocity discharges from Arrowrock Dam have scoured the soils to bedrock. Concrete

footings for some structures and anchor bolts for rigging are all that remain. It is unlikely that 10BO303 retains sufficient integrity to be eligible to the National Register.

Potential for Unrecorded Cultural Resource Sites

There is little potential for intact, unrecorded cultural resource properties in the immediate vicinity of Arrowrock Dam because of extensive disturbance during dam construction and later dam modifications and due to severe erosion from operation of Arrowrock and Lucky Peak Reservoirs. The few undisturbed surfaces near the dam are on very steep, inaccessible terrain unsuited for habitation or most other uses. Further upstream of the dam, as one approaches the south fork of the Boise River, areas of flatter terrain more suitable for habitation exist above the pool. There is the potential for these areas to harbor cultural resource properties. Some of these areas were disturbed by farming by the Nibbler or other families around the turn of the century (Will Gear, 1998).

There is the potential for additional unrecorded cultural resource properties, including traditional cultural properties and human burials within the reservoir pool. The river bottoms, mouths of tributary streams, spring locations, rockshelters, and other locations in the canyon are likely to have attracted people from the Paleoindian through Historic Periods. Representatives from the Shoshone-Paiute Tribes have indicated ancestral graves exist beneath the reservoir, as well as sites of historical or traditional cultural value.

The state of preservation of any site within the reservoir pool–especially in deeper portions of the drawdown zone–is unknown. Eighty-five years of reservoir operation has stripped the soils at some locations to bedrock and then redeposited the eroded materials at a lower elevation in or further downstream in the reservoir pool. Reclamation estimates that since the dam was completed in 1915, 35 to 45 feet of sediment has accumulated at the confluence of the middle and south forks of the Boise River. Cultural resource properties, Indian burial locations, or other locations of historical or traditional importance to the tribes that existed within the drawdown zone may have been destroyed or be deeply buried under sediments

Environmental Consequences

This cultural resource evaluation is limited to Arrowrock Reservoir and Arrowrock Dam. None of the alternatives has the potential to affect cultural resources at other locations.

Impact Indicators/Methods of Evaluation

Arrowrock Reservoir has been in operation since 1915. Therefore, many of the adverse impacts to cultural resource properties, including traditional cultural properties, that could result from reservoir operations have already occurred. If the existing operation and maintenance conditions continued unchanged, these impacts would continue to occur. Therefore, any adverse impacts of the alternatives to archeological or traditional cultural properties would be incremental increases in an existing and typically adverse condition.

Typical impacts from reservoir operations include the following:

- Changes in pool elevation, or maintaining the pool at an elevation that is atypical for that reservoir, can lead to increased erosion of the soil surfaces and banks around and within the reservoir pool. Cultural resource properties and human gravesites are damaged by erosion, and an increase of erosion correlates to an increase in damage to the property or burial. If archeological sites are eroded, artifacts are redistributed and the spatial association is altered or destroyed. This greatly reduces the information that can be gained through future scientific investigation. Artifacts eroded from one site may also be redeposited elsewhere, inhibiting our ability to understand site distribution and function. If a burial is eroded, the associated human remains and funerary objects are exposed and redistributed and not left as intended by those who buried the individual.

- Repeated wet and dry cycles resulting from inundation and exposure of a site increase the rate and extent of destruction of organic materials and metal items within archeological sites.

- Exposure of landforms that contain cultural resource properties or burials may increase the potential for vandalism. If the exposed site or burial is in an eroding location, the artifacts or other materials lying on the ground surface are clearly visible to relic collectors and vandals. The materials are also exposed to unintended damage from sources such as off-highway vehicles (OHV's). Exposed sites also can suffer from wind or surface-water erosion, since inundation has destroyed the vegetative cover that holds the soils in place.

- Erosion and redeposition alters landforms, potentially destroying physical or associative aspects that make the location of traditional cultural value to an Indian tribe or individual.

Arrowrock Dam is listed on the National Register of Historic Places. Changes in the design, removal of original structural or operational elements, or the addition of new elements all reduce the historic integrity of the dam. Cumulative changes could potentially so alter the original design and appearance of the dam so as to make it no longer eligible for the National Register.

No Action

Arrowrock Reservoir

During cyclical drawdowns of Arrowrock Reservoir for the outlet works repair and maintenance, landforms not usually exposed within Arrowrock Reservoir would be above water. All drawdowns (elevation 3050 feet and lower) would expose the South Fork confluence including site 10BO300 and all drawdowns below 3020 feet would expose the area above Dutch Creek. Exposure of usually inundated surfaces would make cultural resource properties that might be present vulnerable to vandalism, unintentional damage by users, and surface erosion. Maintaining the pool at these elevations for 2-5 months during maintenance years could induce

new rounds of erosion at the temporary shoreline. Since much of the lower reach of the reservoir basin consists of basalt cliffs, any impacts would probably be rather rare and localized.

The potential for impacts from vandalism to exposed sites would likely be diminished by reduced boat launching capability and the late season of the drawdown. During the early portion of the drawdown, there could be an increase in the potential for vandalism by OHV operators, curiosity seekers, and others seeing an opportunity to explore the "new" territory. During the late portion of drawdown, snow could obscure the surface and cold temperatures could greatly reduce public visitation.

Arrowrock Dam

The No Action Alternative includes the requirement to implement an aggressive program of actions to repair and rehabilitate the Ensign valves and slide gates. Reclamation anticipates that, at a minimum, this will entail replacing seals and rings, and repairing eroded concrete in the outlet conduits. These kinds of maintenance actions have been completed in the past without damage to the overall original design integrity of the valves. However, it is reasonable to assume that at some point, it will become necessary to extensively rebuild or even replace individual valves and slide gates as they become worn beyond normal repair. Although individual actions of this nature might not significantly detract from the historic integrity of the dam, the incremental accumulation of individual, more extensive repair actions could ultimately diminish the historic integrity of the valves, gates, and dam. Since it is not presently possible to define the kind and extent of more aggressive alterations needed over the life of the dam to maintain this equipment, the cumulative effect upon the dam's historic integrity cannot be assessed at this time.

Mitigation and Residual Effects

As part of the parapet wall replacement and construction of a new bridge across the spillway at Arrowrock Dam, Reclamation proposed to mitigate adverse effects to the historic integrity of Arrowrock Dam by completing a Level II HAER documentation of the dam and its associated (contributing) features. In 1999, in advance of awarding the contract to replace the parapet walls, large-format black-and-white photographs were taken of the dam, spillway, spillway bridge, valve and gate operating equipment, and nearby shop and residential buildings. They document the "current view" appearance of the dam, and were collected and processed in accordance with HAER and Library of Congress standards. As a result the mitigation for the historic integrity of the dam has already been completed or is in progress and would be completed whether or not valve replacement takes place.

Site 10BO300 (the 1860's temporary Indian encampment) is the only formally documented cultural resource property within the reservoir pool although the exact location is uncertain. Reclamation, the Idaho State Historical Protection Officer (SHPO), and the Shoshone-Paiute and Shoshone-Bannock Tribes believe that additional archeological sites, culturally important locations, and human burials may lie within the pool despite the effects of 85 years of reservoir operations. Deep drawdowns associated with No Action would provide an opportunity to "spot

check" areas with high probability of containing intact cultural resource properties or endangered human burials.

Reclamation, the Idaho SHPO, the Shoshone-Bannock, and the Shoshone-Paiute have consulted about cultural resources that might be present in the reservoir, the potential effects of proposed alternatives, and the best actions to address potential effects on archeological sites and culturally important locations. We have agreed that the best approach is to: (a) conduct an archeological reconnaissance of the drawdown zone, (b) more closely examine areas that have high potential to contain significant cultural resources, (c) document identified sites, and (d) conduct monitoring. Reclamation will solicit assistance from the Shoshone-Bannock and Shoshone-Paiute for reconnaissance and monitoring. If sites or other locations of particular interest are identified, Reclamation would complete a remote sensing survey of those locations. This may include limited testing to confirm anomalies or collect other subsurface information. Monitoring is anticipated to occur for two purposes: (a) the periodic surveillance of selected high probability areas throughout the reservoir, implemented as successively lower water elevations occur, and (b) the more intensive monitoring of specific sites, particularly those that might contain human burials, to inhibit looting or vandalism. This may include assigning a monitor to particularly sensitive locations throughout the greatest periods of jeopardy.

Drawdown may expose human burials. As required by the Native American Graves Protection and Repatriation Act (NAGPRA), Reclamation has initiated consultations with the Shoshone-Paiute and the Shoshone-Bannock to identify a strategy to address the inadvertent discovery of human remains during a drawdown. In the event of an inadvertent discovery, tribal notification and consultation, and subsequent treatment of human remains and associated funerary objects, would be implemented consistent with a NAGPRA plan of action to be developed by Reclamation in coordination with the Shoshone-Bannock and Shoshone-Paiute Tribes. Reclamation commits to further consultation with the affected Tribes on a government-to-government basis to avoid, minimize, or mitigate effects in accordance with 36 CFR 800, Executive Order 13007, and Reclamation policy. Consultations will also include traditional cultural properties, sacred sites, and Indian Trust Assets.

As the long-term effect of valve and sluice gate maintenance cannot be determined at this time, no specific appropriate mitigation can be determined. However, Reclamation has already committed to complete Level II HAER documentation of the dam to mitigate the effects of parapet wall replacement and construction of a new spillway bridge. In 1999, in advance of awarding the parapet wall replacement contract, large-format black-and-white HAER photographs were taken of the dam, spillway, 1915 bridge, valve and gate operating mechanisms, and nearby shop and residential buildings. The photographs document the "current view" appearance of the dam, as required for HAER. We anticipate that the Level II HAER documentation would also serve to mitigate for any long-term adverse effects of incremental maintenance. If, in the future, maintenance actions were identified that involved replacement of valves, then separate consultations would be completed with the SHPO.

No residual impacts to cultural resources are anticipated.

Alternative A (Preferred Alternative)

Arrowrock Reservoir

Through the first two construction seasons there would be no new effect on cultural resources in the pool.

The drawdown for Construction Season 3 would be below the normal conservation pool elevation, but above recent low-water elevations, and well above the drawdowns for No Action.

Reclamation, the SHPO, the Shoshone-Bannock Tribes, and the Shoshone-Paiute Tribes agree that the drawdown in Construction Season 3 could increase erosion and exposure of cultural resources to vandalism. Compared to No Action, Alternative A effects would be less damaging and a one-time event. As indicated for No Action, the potential for impacts from vandalism to exposed sites would likely be diminished by reduced boat launching capability and colder temperatures during the late season of the drawdown.

Arrowrock Dam

Implementation of Alternative A would have an adverse effect upon the historic integrity of Arrowrock Dam, primarily due to removal of the 10 original Ensign valves and their associated equipment. Construction of the new gate house and access stairway across the face of the dam would introduce new visual elements, which would further affect the dam's historic integrity.

Mitigation and Residual Effects

Mitigation actions for archeological and traditional cultural properties would be as described for the No Action Alternative.

Mitigation will be required to address the adverse effect of Alternative A on the historic integrity of Arrowrock Dam. As indicated for the No Action Alternative, Reclamation has committed to mitigate the adverse effect of parapet wall replacement and new bridge construction through Level II HAER documentation. We anticipate that this documentation would also serve to mitigate the majority of the adverse effects identified for Alternative A. However, we will implement additional mitigation measures. Reclamation will use the HAER data to prepare public interpretive information about Arrowrock Dam and the important role played by the Boise Project in early 20th Century historic development of southwestern Idaho. Reclamation will also explore the feasibility of salvaging two of the mid-level Ensign valves for use as exhibits at a Reclamation facility or other appropriate location.

Some residual effects would result from Alternative A. Removal of original equipment and alteration of the dam will permanently change the visual character and historic integrity of the dam.

Alternative B

Arrowrock Reservoir

Through the first two construction seasons there would be no effect on cultural resources.

The potential for uncovering cultural resource properties and human gravesites would be less for Alternative B than for No Action (a drawdown 32 feet lower) but somewhat more than for Alternative A (a drawdown elevation about 20 feet higher). The short period of drawdown under Alternative B would reduce the amount of time cultural sites at uncommonly lower levels of the zone are exposed to impacts. In contrast, Alternative B also includes larger flows from Anderson Ranch Dam to meet downstream irrigation demands and these would be at an unprecedented rate for September. As a result there could be increased erosion of cultural sites for a short period but the total impact would be less than for No Action in Maintenance Season 3. Alternative B cultural resource impacts would be greater than those associated with Alternative A.

Arrowrock Dam

The effects on the historical integrity of Arrowrock Dam would be the same as for Alternative A.

Mitigation and Residual Effects

Mitigation for adverse effect to cultural resources would be the same as for No Action and residual effects would be the same. However, archeologists would be working in a more compressed time period for accomplishing a reconnaissance and possible magnetometry survey during Arrowrock drawdown. This would render timely scientific investigations more difficult.

Mitigation for adverse effects to the historical integrity of Arrowrock Dam under Alternative B would be the same as for Alternative A.

Indian Sacred Sites

Affected Environment

Executive Order 13007, Indian Sacred Sites, directs agencies to seek to avoid adverse impacts to Indian sacred sites. The EO defines a sacred site as a "specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion." The tribe or representative of an Indian religion is responsible for informing the agency of the existence of such a site.

The Shoshone-Bannock Tribes have indicated that there are places along the Snake River and its tributaries that still retain their natural integrity enabling tribal members to conduct traditional ceremonial functions (Reclamation, 1995). Various natural and physical features on the landscape hold spiritual or religious significance to the aboriginal Snake River tribes. In Northern Shoshone-Bannock and Northern Paiute religion, spirits are believed to inhabit special places in the landscape, making these locations dangerous and sacred. Ritual precautions, such as bathing or offering gifts, must be performed before going to such places. These sacred places include mountains, foothills, buttes, springs, lakes, rivers, caves, burial places, petroglyph and pictograph sites, and others such as battle or massacre sites (Walker and Matthews, 1996).

The Shoshone-Paiute and Shoshone-Bannock Tribe have indicated that archeological site 10BO300 is a sacred site, because there are likely to be human burials associated with the location. Other specific sacred sites have not been identified, but the Tribes indicate that other burial locations may be present and would also be sacred sites.

Environmental Consequences

Effects on Indian sacred sites are specifically addressed in this section due to their particular importance. None of the alternatives has the potential to affect sacred sites outside of the Arrowrock Reservoir area.

Impact Indicators/Methods of Evaluation

The following assumptions were made and apply to all alternatives:

- Arrowrock Reservoir has been in operation for 85 years. Erosion associated with operation has stripped soils to bedrock in many locations, and redeposited the soil in deep layers in other locations downstream particularly near Arrowrock Dam. It is probable that the characteristics of some sacred locations may have been so drastically altered as to have lost their religious value or be no longer recognizable by traditional practitioners.

- There is a potential that some sacred sites have survived the effects of various Reclamation operations and retain their sacred value to traditional practitioners and the tribes. The Shoshone-Paiute and Shoshone-Bannock Tribes have indicated that human gravesites may be present in the reservoir.

- If human burials or other sacred sites remain in the pool, then the additional erosion that may occur from phases of atypically deep drawdowns could damage or destroy those sites. Periods of unusually deep drawdown could expose graves that are normally not exposed to the dangers of vandalism or surface erosion. Adverse effects that might occur to sacred sites as a result of drawdowns would be **irreversible**. Sacred sites are not amenable to replacement as is possible with some biological resources. Such sites are one time events, and once disturbed or destroyed, it is forever.

- If sacred sites are present within the deep pool areas, traditional practitioners would be able to access the sites for use during periods of unusual drawdown.

No Action

Environmental Consequences

The cyclical inspections occurring every 6 years, which are the hallmark of the No Action Alternative, would require periodic deep drawdowns of Arrowrock Reservoir for 2 to 5 months. During these periods, landforms not frequently exposed would be above water. This would include the area above Dutch Creek including the South Fork confluence where site 10BO300 is located. Exposure of usually inundated surfaces would make human burial sites and other sacred sites in the pool vulnerable to the effects of surface erosion, unintentional damage by users, and vandalism. Maintaining the pool at the lower elevations for the duration of time needed for the repairs could induce a new round of erosion at the temporary shoreline. That could undercut banks and induce slides affecting areas at much higher elevations, thus affecting sacred sites at those elevations.

The potential for impacts from vandalism would probably be diminished by reduced boat launching capability and the late season of the drawdown. During the early portion of the drawdown, there could be an increase in the potential for vandalism by OHV operators, curiosity seekers and others seeing an opportunity to explore the "new" territory. During the winter, snow could obscure the surface and cold temperatures might greatly reduce public visitation.

Mitigation and Residual Effects

We know of a single sacred site location–possible burials associated with site 10BO300. As part of the mitigation program discussed in the Cultural Resources section, Reclamation, the SHPO, and Shoshone-Paiute and Shoshone-Bannock Tribes would conduct a reconnaissance of the probable area of the burials to determine if any are exposed. If burial locations are identified (either during the archeological reconnaissance or subsequent monitoring), Reclamation would implement the NAGPRA action plan for inadvertent discoveries that will be developed by Reclamation in coordination with the Shoshone-Paiute and Shoshone-Bannock Tribes.

Reclamation commits to further consultation with the affected Tribes on a government-to-government basis to avoid, minimize, or mitigate effects in accordance with 36 CFR 800, Executive Order 13007, and Reclamation policy. Consultations will include traditional cultural properties and Indian Trust Assets.

There are no identifiable residual effects to sacred sites.

Alternative A (Preferred Alternative)

Environmental Consequences

The extended exposure of sacred sites during the 5½-month drawdown during Construction Season 3 could increase the adverse effects of erosion and exposure to vandalism. In comparison to No Action, Alternative A effects would be less damaging to sacred sites because the pool elevation would be higher and there would be only one drawdown.

Mitigation and Residual Effects

Actions to mitigate and to minimize impacts would be as discussed for the No Action Alternative.

Alternative B

Environmental Consequences

Construction Season 3 drawdown under Alternative B would be lower (expose more reservoir bottom) than Alternative A, although the elevation would not be as low as for No Action in Construction Season 3. However, Alternative B would be much shorter (9 weeks) as compared to No Action (5 months) and Alternative A (5½ months). In addition, this drawdown would be a one-time event. As a result, the potential for damage to sacred sites would be less than for No Action, although likely to be equal to or more than Alternative A.

Mitigation and Residual Effects

Actions to mitigate and to minimize impacts would be as described for the No Action Alternative.

Indian Trust Assets

Affected Environment

ITA's are legal interests in property held in trust by the United States for Indian tribes or individuals. The Secretary of the Interior, acting as the trustee, holds many assets in trust for Indian tribes or Indian individuals. Examples of things that may be trust assets are lands, minerals, hunting and fishing rights and water rights. While most ITA's are on-reservation, they may also be found off-reservation.

The United States has an Indian trust responsibility to protect and maintain rights reserved by or granted to Indian tribes or Indian individuals by treaties, statues, and executive orders. These are sometimes further interpreted through court decisions and regulations.

The Shoshone-Bannock Tribes, a federally recognized Tribe, located at the Fort Hall Indian Reservation in southeastern Idaho have trust assets both on- and off-reservation. The Fort Bridger Treaty was signed and agreed to by the Bannock and Shoshone headman on July 3, 1868. The treaty states in Article 4, that members of the Shoshone-Bannock Tribe "... shall have the right to hunt on the unoccupied lands of the United States ...." This has been interpreted to mean unoccupied federal lands.

The Tribes believe their right extends to the right to fish. The Fort Bridger Treaty for the Shoshone-Bannock has been interpreted in the case of *State of Idaho v. Tinno,* an off-reservation fishing case in Idaho. The Idaho Supreme Court determine that the Shoshone word for "hunt" also included to "fish." Under *Tinno*, the Court affirmed the Tribal Members' right to take fish off-reservation pursuant to the Fort Bridger Treaty (Shoshone-Bannock Tribes, 1994)

The Nez Perce Tribes are a federally recognized Tribe located at the Nez Perce Reservation in northern Idaho. The United States and the Tribes entered into three treaties (Treaty of 1855, Treaty of 1863, and Treaty of 1868) and one agreement (Agreement of 1893). The rights of the Nez Perce Tribes include the right to hunt, gather and graze livestock on open and unclaimed lands, and the right to fish in all usual and accustomed places (Nez Perce Tribes, 1995).

Other federally recognized Tribes, the Shoshone-Paiute Tribes of the Duck Valley Reservation located on the Idaho/Nevada border, and the Burns Paiute near Burns, Oregon do not have off-reservation rights outside their Executive Order Reservations (Department of the Interior, 1997). These Tribes may have cultural and religious interests in the area of Arrowrock Reservoir. These interests of the Tribes may be protected under historic preservation laws and NAGPRA. See previous sections (Cultural Resources and Sacred Sites) for a discussion of other Tribal interests.

Environmental Consequences

There is no universally accepted understanding as to the specific treaty rights to hunt and fish in the vicinity of Arrowrock Reservoir since there has not been a settlement with either the Nez Perce Tribe or the Shoshone-Bannock Tribe as to the extent and nature of their off-reservation hunting and fishing treaty rights. Thus the ITA's considered are tribal hunting and fishing rights that may exist. Water right claims, or the lack of such claims, within the Snake River Basin Adjudication are not necessarily determinative of these kinds of rights.

The rights of the tribes to hunt and/or fish would not be altered by any of the alternatives; however, the availability of fish and game might be impacted. Potential changes in this availability would be limited to the Arrowrock Reservoir and Lucky Peak Lake areas and the lower Boise River. This analysis is confined to that geographic region.

Impact Indicators/Methods of Evaluation

Access to the area for hunting and fishing is the primary impact indicator. Indirect impacts to resources associated with the ITA of hunting and fishing would be indicated by changes in fish, waterfowl, and game populations.

Environmental Consequences

Discussions under the water quality, fish, and vegetation and wildlife sections of this chapter indicate that the only potential change in fish and wildlife population or habitats would be to waterfowl and fish. Open water habitat for waterfowl would be greatly reduced or eliminated at Arrowrock Reservoir in every sixth year under the No Action Alternative and in one year under the action alternative. However, open water habitat would be available at Lucky Peak Lake to provide waterfowl needs. As a result the overall change in waterfowl availability would likely be negligible. No Action would have short-term and long-term adverse effect on fisheries. Alternative A and Alternative B would have an adverse effect on the fisheries during the construction period and for a period of 1-4 years after, with Alternative A having less adverse effect. In the long term, Alternatives A and B would benefit fish.

Although there may be some impacts to the populations of fish and other game, access to hunting and fishing areas would not be affected. In summary, none of the alternative would affect tribal hunting and/or fishing rights.

Reclamation commits to further consultation with the affected Tribes on a government-to-government basis to avoid, minimize, or mitigate effects in accordance with 36 CFR 800, Executive Order 13007, and Reclamation policy. Consultations will include traditional cultural properties and sacred sites.

Cumulative Impacts

Cumulative impacts are those effects on the environment resulting from the incremental consequences of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes these actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. Minor/non-significant effects or significant localized effects may contribute to cumulative effects.

The proposed action would not be implemented in a vacuum. Implementation would occur with other actions, events, and trends taking place at local and regional levels. For purposes of this discussion, other related actions may be generated by five major entities: (1) Reclamation, (2) other Federal agencies, (3) the State of Idaho, (4) county or other governmental agencies, (5) non-governmental organizations, and (6) private individuals. Each of these groups will continue to initiate actions that will affect the environment through the foreseeable future. These entities may coordinate their efforts with Reclamation through cooperative programs and efforts or through technical assistance from one or more Federal agencies.

Other activities planned or already carried out by Reclamation which could add to the cumulative impacts of the proposed action include:

- Other operation and maintenance activities at Reclamation dams and reservoirs in the Boise River Basin
- Day to day water management and operations associated with the Boise River reservoir system
- Implementation of actions to protect and conserve threatened bull trout and other special status species

Some of the activities that other entities may carrying out which would have cumulative effects relative to the proposed action include:

- Forest management practices in the Boise River basin
- Implementation of actions to protect and conserve special status species
- Road construction and maintenance
- Construction and maintenance of public utilities and distribution facilities
- Potential contaminant spills or intrusions into stream channels

Events that could influence cumulative impacts may include storm events, forest fires, or other calamities typically referred to as “Acts of God.” Trends related to climatic conditions, i.e. wet, average, or dry cycles, could also be cumulative to the effects of the proposed action, as described previously in this document.

Other changes that are now affecting (and will continue to affect and transform) communities in the Boise River Basin include:

- Regional population growth
- Changing demographics
- Conversion of agricultural lands to residential and commercial uses
- Economic competition and restructuring
- Changing laws, policies, and practices implemented by other Federal and State agencies

Pertinent Activities, Events, and Trends

The following activities may affect some or all of the same resource areas that are potentially affected by the proposed action. Land and water resources, water quality, recreation, biological resources, and socioeconomic resources are all affected, directly or indirectly, by these activities. Their inter-relationships may be complex and not fully understood. Together, these activities may have more impact over the long-term than the either of the action alternatives.

- Replacement of Arrowrock Dam parapet walls as described in Chapter 1
- Replacement of Arrowrock Dam spillway bridge as described in Chapter 1
- Replacement of Arrowrock Dam Telephone Line as described in Chapter 1
- Other potential, but yet unidentified, construction activities related to public utilities
- Hydropower Development at Arrowrock Dam as described in Chapter 1
- Improvement of Atlanta Road as described in Chapter 1
- Other potential road construction, but yet unidentified, and maintenance activities
- Past and recent forest fires in the upper Boise River Basin
- Specific forest management activities as authorized under the Boise National Forest Management Plan, i.e., logging, grazing, mining, recreation development and management, road and trail maintenance, etc.
- Continuing water operations under the Boise Project as described in Chapter 3
- Bull trout conservation measures as described in Chapters 1 and 3
- Fishery management practices/objectives as described in Chapter 3

Water Resources

Construction of the dams and reservoirs in the Boise River system and their operation has changed the magnitude and timing of streamflows. The dam and reservoir system is operated in a coordinated manner to provide the benefits authorized by law, i.e., water for agriculture uses, M&I uses, recreation, fish and wildlife, and flood control. Changes to operation scenarios are largely due to climatic trends and cycles. Other influences which may affect the amount of seasonal runoff into streams and project reservoirs would be land practices such as logging and grazing on forest lands in the basin as well as past and recent forest fires that have denuded thousands of acres. Potential powerplant construction and operation at Arrowrock Dam would not impact water operations because flow through the powerplant (up to the maximum capacity) would be determined by normal operations, that is, no flows would be released through the powerplant specifically for the purpose of generating power.

Water Quality

Routine road maintenance activities such as grading and culvert replacement add to the silt load of streams in the basin as do construction of new roads, e.g. logging roads. Land management practices such as grazing, mining, and logging also result in temporarily disturbed soils which are more easily erodible. Forest lands that have been denuded by forest fires are highly susceptible to erosive forces of wind and water and have resulted in increased silting. These eroded soil materials have added significantly to the deposits in Arrowrock Reservoir which will, through erosive processes, add to the degradation of water quality during reservoir drawdowns under all alternatives.

Potential powerplant construction at Arrowrock Dam would likely have no cumulative effect on water quality if construction were timed to include a No Action maintenance year. Under Alternative A or B, construction of the powerplant would most likely require one or more additional drawdown seasons or would possibly require construction of a large coffer dam, resulting in temporary increases of TSS in Lucky Peak Reservoir. In the long term under all alternatives, operation of a powerplant could possibly reduce future TDG exceedences in Lucky Peak Lake if flood control operations change at Arrowrock Dam.

Fish

Ongoing influences on water quality and flows in the basin in combination with fishery management practices will continue to be the major force affecting the health and productivity of the Boise basin stream and reservoir fisheries over the long term. The No Action alternative would tend to be a continual adverse influence on the fishery resource, while Alternative A and B could result in long-term improvements to the Arrowrock Reservoir fishery.

In 1999, the USFWS issued a BO, under authority of Section 7 of ESA, covering Reclamation's operation in the upper Snake River, including the Boise River (USFWS 1999). USFWS indicated under an RPM for bull trout that Reclamation must work to ensure that reservoir operations do not result in de-watering to the extent that adfluvial bull trout resident there during part of their life history are stressed or killed. As part of this RPM, the USFWS identified a Term and Condition requiring Reclamation to initiate an investigation of alternatives for creating a fisheries conservation pool in Arrowrock Reservoir. Under the No Action Alternative, maintenance of such a pool in every year is not possible, although when maintained in other than drawdown years, a conservation pool would help in re-building Arrowrock fish populations that are lost during maintenance drawdowns every sixth year. Under Alternatives A and B, sustained maintenance of a fishery conservation pool, would be possible and, if implemented, would help re-build fish populations adversely affected during project drawdown. The fishery conservation pool would help sustain a viable fishery in the reservoir for the future.

Vegetation and Wildlife

Influences on vegetation and wildlife in the Boise basin are primarily associated with forest management practices, roads, recreational activities, calamities such as forest fires, and climate. The effects of the No action Alternative to vegetation and wildlife are not expected to add significantly to the cumulative effects of past, present, and future actions in the basin. Cumulative impacts of Alternatives A would be essentially the same or slightly less than for No action; whereas, Alternative B would be somewhat more than Alternative A.

The Arrowrock powerline and road improvement may destroy or degrade small amounts of upland vegetation and wildlife habitat. Implementation of the USFWS BO terms and conditions with regard to bull trout may result in a larger conservation pool for Arrowrock Reservoir and some additional open water habitat for waterfowl and other water oriented wildlife species during fall and winter except in the No Action maintenance years.

If approved, construction of a powerplant at Arrowrock Dam, may result in temporary effects on a small amount of vegetation and local wildlife; however any adverse impacts would most likely be mitigated to the extent that any residual impact would be insignificant. Powerplant operation would not affect vegetation and wildlife.

Threatened and Endangered Species

Influences on the threatened bull trout population would be essentially the same as described for fish. As described for fish, Reclamation is studying the RPM for creating a conservation fisheries pool in Arrowrock Reservoir as a measure to recover and conserve the adfluvial bull trout population. Maintenance of a minimum pool would help to rebuild and maintain the Arrowrock bull trout population lost during maintenance drawdowns. Re-consultation and new RPM's would likely be needed under No Action since the current RPM could not be fully implemented since the No Action requires maintenance drawdowns every sixth year. Under Alternatives A and B, sustained maintenance of a fishery conservation pool, if implemented, would help re-build the bull trout population adversely affected during the single construction season drawdown. Thereafter, the conservation pool would help sustain and rebuild the adfluvial bull trout population for the future.

Influences on the fishery resources in the basin indirectly affect wintering and nesting bald eagles in the basin, since fish are a primary prey source for the eagles. The No Action alternative would add to any long-term adverse impacts on bald eagles which utilize fish upstream and in Arrowrock Reservoir. Alternatives A and B would be beneficial to the long-term sustenance of bald eagles in the Arrowrock Reservoir area.

Other cumulative impacts to eagles are generally associated with disturbance factors associated with various human activities including road construction and maintenance, recreational activities, habitat alterations, and harassment (also see Vegetation and Wildlife). The effects of the alternatives, relative to bald eagle disturbance factors, are not expected to add significantly to the cumulative effects of past, present, and future actions in the basin.

Recreation

Recreational pursuits in the Boise River basin are generally influenced by the season of year, by the amount and ease of access (i.e., availability and condition of roads), and the availability of the resource being used or exploited. Population growth in the Boise area is a major factor affecting the amount of recreation and the recreation experience. Reservoir drawdowns under the various alternatives would have little effect on recreation users at Arrowrock, and the No Action Alternative would have little effect on recreation in any area. However, Alternative B would have a significant adverse effect on recreation at Lucky Peak Lake and along the lower Boise River. Alternative B would have a much less adverse impact along the lower Boise River. The No Action and action alternatives would probably have little effect on traffic in the Lucky Peak and Arrowrock areas. However, the proposed Atlanta Road Project would provide better access into the Arrowrock area and could result in increased recreation traffic into that area resulting in conflicting cumulative effects during drawdown periods for any alternative. During drawdown periods, displacement of recreationists to other areas could change patterns of preference and use in the basin.

If approved, construction of a powerplant at Arrowrock Dam, would result in drawdown of Arrowrock Reservoir and Lucky Peak Lake, and could affect streamflows of the lower Boise River. Impacts to recreation would be minimal if depending on the timing and length of drawdown. Powerplant operation would not affect vegetation and wildlife.

Economics

Operation of the Boise River basin reservoirs focuses on flood control, providing minimum streamflows and accommodating reservoir recreation, and the provision of irrigation water supply, the authorized purpose of Arrowrock Reservoir. Flood control operations would not be affected by the alternatives. The irrigated agricultural economy of the Boise Valley is influenced as much or more by national economic conditions, agricultural commodity market prices, production costs, financial markets, weather events, including droughts, and seasonal agronomic conditions than it is by the availability of irrigation water supplies. Historically, with natural flow rights and reservoir storage contracts, Boise Valley irrigators usually have a sufficient water supply.

However, irrigation districts which hold shareholder contracts or water service contracts from project reservoirs rely on the water supply to maintain their economic livelihood. The primary adverse effect to water supply is the reduced runoff in dry years. The alternatives would not significantly reduce water supplies in good or wet years, but would incrementally decrease water supply by a minor amount in dry years. This impact, although minor by itself, would impact individual irrigators more significantly when combined with the previously mentioned factors. For example, a “drought” like that in 1977 or 1992 combined with the drawdown for construction could indeed cause a significant reduction in irrigation water supplies. The economic impact on irrigators and the local economy would depend on a number of factors, including the timing of the shortage, any advance notice to allow for crop substitution, and other economic and natural factors.

Recreation economic impacts are dependant on visits at reservoirs and other recreation sites. Reduction of visits could adversely affect concessionaires' revenue stream. This effect is not expected to be significant over the long-term for Alternatives A or B, but could be a repetitive situation under the No Action that requires periodic drawdowns for inspection and maintenance.

Cultural Resources

Adverse effects on cultural resources may occur at any time in the Boise River basin as a result of ongoing and planned activities associated with forest management activities, road construction, or other ground disturbance factors. Adverse effects to cultural resource at Arrowrock Dam have occurred recently and can be expected in future years. In addition to impacts associated with the alternatives, the Atlanta Road Improvement Project and the Arrowrock Dam Telephone Line Replacement have the potential to adversely affect and compound disturbance to archaeological sites in the area. That potential is slight as there are very few known archaeological sites around the perimeter of Arrowrock Reservoir.

Actions with cumulative effects on the historic integrity of Arrowrock Dam include: (1) replacement of the parapet wall (completed in year 2000) and (2) construction of a new bridge across the spillway (scheduled for early 2001). Another potential is construction of a powerplant at the dam. All of these actions add intrusive elements not associated with the original dam construction and compromise the historic integrity of this National Register property and will require appropriate mitigative actions as described in this document.

Indian Sacred Sites

All of the alternatives have the potential to affect sacred sites through reservoir drawdown. Several activities in the vicinity of Arrowrock Dam, unrelated to the valve replacement project, have the potential to adversely affect and compound disturbance to sacred sites, if any are present in the area. These projects include the Atlanta Road Improvement and the Arrowrock Dam Telephone Line Replacement projects.

Indian Trust Assets

It is not known to what extent trust assets may be affected by other past, ongoing, or future actions in the Boise basin. However, as described in this document, the proposed action would temporarily affect fish and wildlife resources, but would not affect tribal hunting and /or fishing rights in the basin.

Unavoidable Adverse Effects

Unavoidable adverse impacts are environmental consequences that cannot be avoided either by changing the nature of the action or through mitigation, if the action is taken.

Most of the adverse environmental effects for all alternatives, including No Action, are attributable to the deep drawdown of Arrowrock Reservoir and associated operational changes in the reservoir system. No reasonable alternative to avoid drawdown-related adverse effects and meet the purpose and need for the project could be identified. Alternative A, the Preferred Alternative, was developed to minimize these effects to the extent practical. Mitigation measures developed for all three alternatives would lessen some impacts, but the following major unavoidable adverse impacts would remain even with mitigation:

- Short term elevated levels of suspended sediment, in excess of state water quality standards in some areas
- Mortality, entrainment, and short-term habitat degradation to threatened bull trout
- Short term loss of bald eagle nesting productivity
- Loss of recreation opportunities at Lucky Peak Lake and Arrowrock Reservoir
- Loss of hydropower generation at Lucky Peak Powerplant
- Adverse effects to historical integrity of Arrowrock Dam (Alternatives A and B) and potential effects to other cultural resources and Indian sacred sites
- Economic impacts to irrigation districts and individual members from project repayment obligations

Irreversible and Irretrievable Commitments of Resources

Irreversible and irretrievable commitments of resources are effects to resources that cannot be recovered or uses of resources that are forgone over a period of time as a result of a decision.

The environmental effects of Alternatives A and B are mostly temporary. Resources such as water quality, recreation, and socioeconomics would be adversely affected only during the construction period or for a short time afterward. These effects would be neither irreversible nor irretrievable. Other resources such as fisheries and threatened and endangered species, especially bull trout, would be affected for a longer period of time. Although these resources would recover to their present state within a few years, and in some cases would improve in the future, the forgone uses of these resources would be considered irretrievable.

The physical alteration of Arrowrock Dam under both action alternatives would be considered an irreversible effect to the historic integrity of the structure. Even though mitigation measures would preserve a historic record, the dam would be forever changed. Also, if archeological resources, traditional cultural properties, or sacred sites are affected through erosion or vandalism, these too would be considered irreversible effects.

For the No Action alternative, the adverse effects from reservoir drawdowns during the continuous regular maintenance cycles would result in irretrievable effects to all adversely affected resources since there would be recurrent forgone opportunities each time inspection and maintenance of the dam's outlet works is conducted. There would be no irreversible effects to the historic integrity of the dam under No Action, however potential irreversible effects to archeological resources traditional cultural properties, or sacred sites would remain.

4 CONSULTATION AND CORDINATION

4 CONSULTATION AND COORDINATION

Public Scoping and Involvement

In November, 1998, Reclamation mailed a scoping document to over 100 individuals, organizations, and agencies. The document discussed the deficiencies in the outlet works and requested comments on a proposal to replace the lower ten Ensign valves with clamshell gates. The mailing also announced two scoping meetings that were held in December, 1998. Notice of these meetings was also made in the *Federal Register*. A letter with a summary of comments and issues identified during the scoping process was mailed to the public in March, 1998. These comments assisted in refining the alternatives that are included in the EIS.

Reclamation has continued to meet with the Irrigation Districts, Tribes, USFWS and state and local agencies to keep them apprised of the progress of the project and share available information. When requested, Reclamation has also met with interest groups, local Watershed Advisory Groups and the Boise River 2000 group to explain the project.

In December 1999 an Arrowrock Update was published and distributed to those who had shown an interest or requested notification. At the same time an Arrowrock web page (www.pn.usbr.gov/reg/ida/arrowrock.html) was developed, and information in the update was published on the web page.

Reclamation has attended several meeting of the Southwest Basin Native Fish Watershed Advisory Group to provide an overview and updates on the progress of the Arrowrock Outlet Works Rehabilitation. Presentations were made to a variety of recreation interests including Boise River 2000, Recreation Safety Group, and others. Attendance at these meetings included Federal, State and local agencies including IDFG, Ada County Parks and Waterways, and Idaho State Parks, CORE, and city of Boise and Ada County representatives.

Meetings have also been held with the IDEQ and other groups concerned with water quality issues. A multi-year community outreach plan is being developed to keep the public informed of construction and/or maintenance.

A Draft EIS for public review, issued on October 23, 2000, provided opportunities for public review and comment for a period of 60 days. Notice of this document was made in the *Federal Register* on October 26, 2000 (Vol. 65, No. 208, page 64234). Sixteen letters of comments were received. The letters and Reclamation response to those comments can be found in Appendix K. Main areas of concern were economics, safety, dissemination of information/status updates, repayment, water quality, fish, and recreation impacts. Copies of this Final EIS are being sent to the addresses identified by one or two asterisks in the distribution list (Appendix H). The Final EIS will also be published on Reclamation's web page (see above) for approximately 1 month after the Record of Decision is published.

On November 2, 2000, a public information open house to describe the problems and proposed action of rehabilitation of the outlet works was held. Approximately 63 individuals representing the general public, organizations, irrigation districts, Federal, State, and local agencies attended. Areas of main interest were fish, wildlife, economics, and recreation.

Two formal public hearings were conducted at the Idaho State Historical Museum, 610 North Julia Davis Drive, in Julia Davis Park, Boise, Idaho on December 12, 2000. Seven individuals gave formal testimony at the first session, but no one wanted to give testimony in the second session. The testimony given at these hearings mirrored and was incorporated in the letters of comments received on the Draft EIS. Therefore, the responses to comments cited in Appendix K also represent the responses to the comments made at the hearing testimony. Notice of the formal public hearings were made in the *Federal Register*.

Coordination with Federal and State Agencies

Reclamation consultations have included the USFWS, NMFS, IDFG, Idaho SHPO, and others. Consultations by specific requirements are summarized below.

Fish and Wildlife Coordination Act

In accordance with FWCA, Reclamation met with the USFWS and the IDFG to discuss potential impacts to fish and wildlife. On September 16, 1999 USFWS provided Reclamation with a Draft Fish and Wildlife Planning Aid Memorandum addressing potential effects of the project. The information in the draft memorandum was used by Reclamation in formulating alternatives and assessing impacts. On January 19, 2001, USFWS provided Reclamation with a Final Fish and Wildlife Coordination Act Report [file # 1009.0405/OALS #01-0231] (USFWS, 2001). The report provides recommendations for mitigation and enhancement of fish and wildlife. Reclamation. Reclamation has agreed to implement most, but not all of the recommendations. A summary of the USFWS recommendations from the FWCA Report and Reclamation responses are included in Appendix F.

Endangered Species Act

In accordance with Section 7(c) of the Endangered Species Act, Reclamation requested a list of threatened and endangered species from USFWS on September 22, 1998. USFWS provide the list to Reclamation on October 21, 1998. Updated species lists were subsequently requested and received on July 19, 1999 and August 4, 2000. Several informal consultation meetings were held with USFWS and IDFG throughout this period to clarify aspects of the project, assist in formulating alternatives, and identify means of avoiding adverse effects. Reclamation submitted a Preliminary Draft BA evaluating the project effects to bull trout, bald eagle, gray wolf, and Ute ladies'-tresses on September 5, 2000.

On January 19, 2001 Reclamation received a Draft Biological Opinion [SP#1-4-00-SP-785] (BO) from the USFWS. The Draft BO concurs with Reclamation's determination that the Preferred Alternative (Alternative A) would adversely affect bull trout and nesting bald eagles and would not affect gray wolf or Ute ladies'-tresses. The Draft BO also provides RPM's and Terms and

Conditions to minimize take of bull trout and bald eagles. A summary of the RPM's and Terms and Conditions is included in Appendix F.

Reclamation responded to the Draft BO on February 14, 2001 stating that Reclamation agrees to reduce the incidence of bull trout entrainment due to reservoir operations, initiate studies necessary to develop a long-term entrainment-reduction solution, progressively implement interim measures to reduce entrainment from Project operations, initiate water quality monitoring/modeling efforts to determine water quality parameters and conservation pool necessary to support adfluvial bull trout in Anderson Ranch and Arrowrock Reservoirs, initiate a capture and transport program to move bull trout entrained at Arrowrock Dam back upstream so they can complete their spawning and foraging migrations in tributaries above Arrowrock Reservoir, and within existing authorities and voluntary partnership opportunities, work towards ensuring reservoir operations do not result in de-watering of Arrowrock Reservoir to the extent that adfluvial bull trout resident there during part of their life history are stressed or killed.

Reclamation agrees to work with the Boise National Forest to prepare a bald eagle nest site management plans for the two bald eagle nests at Arrowrock and determine, in cooperation with USFWS, Boise National Forest, and IDFG, the potential need and effectiveness of supplemental winter feeding of bald eagles at Arrowrock Reservoir.

USFWS anticipates issuing a Final BO in March 2001. If the RPM's and Terms and Conditions change in the Final BO, Reclamation would implement these changes.

NMFS provided Reclamation with a list of ESA species on November 16, 1998. This list was confirmed with NMFS on August 10, 2000. Reclamation has determined that the alternatives analyzed in this EIS would not affect listed anadromous fish species. This determination meets Reclamation's consultation requirements under Section 7(c) of ESA.

National Historic Preservation Act

In the fall of 1998, Reclamation began consultations with the Idaho SHPO, per Section 106 of the National Historic Preservation Act concerning treatment of impacts on archeological and traditional cultural properties. At the same time, Reclamation began a series of face-to-face meetings and formal written consultation with the Shoshone-Bannock Tribes of Fort Hall and the Shoshone-Paiute Tribes of the Duck Valley Indian Reservation. All consulting parties concur that adverse impacts could occur under all alternatives.

In 1998, Reclamation consulted with the Idaho SHPO about the effect of replacing the concrete parapet walls along the crest of Arrowrock Dam. The effect of the parapet replacement to the historic integrity of the dam, other upcoming alterations to the dam, the potential effects of valve rehabilitation and replacement, and construction of a new bridge were discussed. Reclamation and the SHPO agreed that the cumulative effects of these actions would have an adverse impact on the historic integrity of Arrowrock Dam. In July 2000, Reclamation initiated formal Section 106 consultations with the SHPO on the effects of the valve replacement and

rehabilitation alternatives on the historic integrity of Arrowrock Dam. In September, the SHPO concurred that Level II HAER was an appropriate treatment to mitigate the adverse effects of the valve replacement. Consultations will culminate in a memorandum of agreement that documents commitments to minimize and mitigate adverse impacts.

Coordination with Native Americans

Since fall of 1998, Reclamation has sought to keep the Tribes informed of the Arrowrock Outlet Work Rehabilitation and to hear their concerns (see Appendix G for a list of letters and meetings). In 2000, Reclamation requested official NAGPRA consultations with the Shoshone Paiute, Shoshone Bannock and Burns Paiute Tribes and also offered the Tribes another opportunity to comment on the portion of this draft document regarding cultural resources and Indian Trust Assets in the area affected by the Arrowrock Outlet Works Rehabilitation. Reclamation will continue to keep the Tribes informed and to seek their comment.

On February 7 and on February 15, 2001, Reclamation met with Tribal members of the Shoshone-Paiute and Shoshone-Bannock Tribes on each reservation respectively to garner any concerns or comments. As of the date of this Final EIS, no comments have been received. Reclamation has committed to continuing the positive government-to-government consultations it has developed with each Tribe to avoid, minimize, or mitigate effects in accordance with 36 CFR 800, Executive Order 13007, and Reclamation policy. Reclamation will continue to keep the Tribes informed and to seek their comment. Consultations will include traditional cultural properties, sacred sites, and Indian Trust Assets.

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5 BIBLIOGRAPHY

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6 LIST OF PREPARERS

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7 GLOSSARY

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Acre – 43,560 square feet.

Acre-foot – Volume of water equivalent to 1 foot deep over an area of 1 acre; 43,560 cubic feet or 326,000 gallons

Action Alternative – An alternative that requires direct action by proposing agency

Active Storage – The total amount of space that can be filled with water and the water released for specific purposes under normal circumstances. (see also storage capacity)

Adfluvial - life history form which migrates between lakes/reservoirs and streams

Alluvial/Alluvium – Refers to sediments deposited by flowing water as in a riverbed, flood plain, or delta.

Bellmouth – The flared inlet opening to a pipe.

Bubbler – A compressed air system that releases bubbles into water to prevent the formation of ice.

Bulkhead – A wall that acts as a barrier to water flow, usually used to provide dry conditions for construction or maintenance activities..

Bulkhead gate – A gate used for temporary closure of conduit before dewatering it for inspection or maintenance.

Carrion – The dead and putrefying flesh of an animal.

Cavitation – The formation of partial vacuums in fast-flowing water caused by subatmospheric pressures immediately downstream from an obstruction or offset. Usually accompanied by noise and vibration. The collapse of the gas pockets or bubbles drives water into the surfaces with a terrific force that can cause pitting.

Clamshell Gate – A high pressure regulating gate consisting of two curved leaves which open and close over the end of a type of water conduit. The two gate members rotate on an axis upstream of the opening and form a seal when closed that centers on the conduit opening.

Cofferdam – A temporary watertight enclosure that can be pumped dry to provide dry conditions for construction or maintenance activities; may consist of several bulkheads. May also be a watertight chamber attached to a solid surface to facilitate repairs below the water line.

Conduit – A closed channel to convey water through, around, or under a dam.

Cubic feet per second – Unit of flow; 448.8 gallons per minute; 1.98 acre-feet per day.

Cultural resource(s) – Any building, site, district, structure, or object significant in history, architecture, archeology, culture, or science.

Dead Storage – The volume of water that lies below the lowest outlet and cannot be released by gravity flow (see also storage capacity).

Drawdown – The lowering of a reservoir water level.

Drum Gate – A movable crest gate in the form of a section of a cylinder hinged at the centerline. The arc face effects a seal with the edge of a recess and the gate is operated by a reservoir pressure. A type of spillway gate consisting of a long hollow drum hinged at either the upstream or downstream end. In the type called the Reclamation Drum the hinge is on the upstream edge. The drum may be held in its raised position by the water pressure in a flotation chamber beneath the drum. Design permits overtopping.

Elevation – Elevation is expressed as feet above mean sea level.

Endangered Species – A species which is in danger of extinction throughout all or a significant portion of its range.

Ensign Valve - A type of needle valve developed by O.H. Ensign while he was the Chief Electrical Engineer for the U.S. Reclamation Service (Bureau of Reclamation) in the early 1900's. The Ensign Valve is a hydraulically balanced water control valve, consisting of a cylindrical steel structure having a circular inlet and a central discharge. On the upstream side, a water-actuated piston moves inside the cylinder, while on the downstream end of the piston, a needle moves relative to a cylindrical discharge ring to control the flow of water.

Entrain(ment) – To pass through the outlet facilities of a dam.

Exceedance curve – A graphic that compare a function against time to shows the percent of time that a specific value is exceeded.

Fluvial – Of or relating to a river or stream. Life history form that migrates between small tributaries and larger streams.

Habitat – The environment of a biological population.

Hydraulic Head – The difference in height, usually in feet, from the free surface of a body of water to a level below the surface. The greater the hydraulic head the greater the pressure of the water.

Hydrograph – A graphical representation of water surface elevation or flow as a function of time.

Hydrology – The science of water in nature: its properties, distribution, and behavior.

Inactive Storage – The amount of storage normally not released but maintained in a reservoir for specific purposes such as hydraulic head for power generation, sediment control, or a conservation pool (see also storage capacity).

Instream Flows – Water flows for designated uses within a defined stream channel such as minimum flows for fish, wildlife, recreation, or esthetics.

Irretrievable – See irreversible.

Irreversible – A commitment of resources that cannot be reversed, except perhaps in the extreme long term. An extinct species is the classic instance of an irreversible loss.

Limnology – Study of physical, chemical, and biological conditions in fresh water, especially lakes and ponds

Magnetometry – An investigative technique that measures magnetic intensity. Generally used to find objects hidden beneath soil or water.

Mitigation – The avoidance or minimization of the magnitude of an impact by not taking certain actions or parts of an action. Also includes repair, rehabilitation and restoration or compensation with substitute resources after an action occurs.

MODSIM – A computer model used to simulated the hydrology of a stream.

No Action Alternative – The alternative that describes the most likely future conditions that would exist without implementation of the action alternatives. The no action alternative serves as a base to measure the effects of the action alternatives.

Outlet Works - The constructed means by which water can be released from a reservoir. Includes spillways, conduits, various valves and gates, and protective structures.

Parapet – A solid wall built along the top of a dam.

Public – Any interested group or individual, including Federal, State, and local agencies, special-interest groups, ad hoc groups, and the general citizenry.

Riparian – Related to, living on, or located on a water course.

River Mile – The distance in miles from the mouth of a river to a given point upstream as measured following the center of the stream bed.

Riverine – Riparian.

Rule Curve – A graphic illustration or table developed for a specific reservoir or system of reservoirs to be used in operating and maintaining reservoir space or water levels. The most common type is the flood control rule curve used to help reduce downstream flooding.

Sacred Site – Any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian Tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred.

Sediment – Any very finely divided organic or mineral matter deposited by water in nonturbulent areas.

Slide Gate – A steel gate that upon opening or closing slides on its bearings in edge guide slots. A gate that can be opened or closed by sliding in supporting guides.

Spillway – A type of outlet works associated with a dam for release of water above a specific elevation. Overflow channel of a dam.

Sluice Gate – A gate, regardless of construction type, that is usually the lowest level outlet and can be used to wash away sediment buildup.

Standing Operating Procedure (SOP) – A set of procedures that serve as guidelines for the operation of a specific site or facility. Included are instructions that refer to safety, maintenance, and general operation. Deviation from the SOP generally requires specific approval at a high level.

Stoplog – At one time logs or wooden beams, but now mostly steel beams that can be stacked atop each other to form a water tight wall. The ends of the steel beams are held in metal guides. Used to form a temporary bulkhead.

Storage Capacity – The maximum volume of space available in a reservoir. Storage space is typically allocated among the following: surcharge, active, inactive, and dead storage but need not include all four allocations. Surcharge space is not normally filled or included in the storage capacity figure.

Stratified – Refers to the development of thermal layers in a body of water.

Surcharge – The act of filling a reservoir above the normal maximum water surface level. Surcharge generally requires specific permission and is usually released as soon as possible.

Take - To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct.

Threatened Species – A species which is likely to become endangered within the foreseeable future.

Total Dissolved Gases – A measure of the amount of atomospheric gases dissolved in water. Usually measured as a percentage, with 100 percent representing the maximum concentration under normal circumstances.

Total Suspended Solids – A quantitative measure of the residual mineral dissolved in water that remains after the evaporation of a solution. Usually expressed in milligrams per liter or parts per million. Total amount of dissolved material, organic and inorganic, contained in water.

Total Maximum Daily Load – The sum of the individual waste load allocations for point sources, load allocations for nonpoint sources, natural background, and a margin of safety that a body of water can take without threatening beneficial uses. TMDL can be expressed in terms of mass per time, toxicity, or other appropriate measure that relates to a state's water quality standard.

Total Storage Capacity – The reservoir capacity below the normal maximum water surface elevation. Does not include surcharge capacity.

Trashrack – A coarse protective screen usually constructed of heavy metal members designed to protect conduits and valves from impact and damage by floating objects such as trees, parts of trees, and other debris.

Turbidity – The scattering and absorption of light that makes water look murky; caused by matter suspended in the water. Caused by the content and shape of matter suspended in the water.

Turn over – Mixing from top to bottom in a lake due to seasonal difference in temperature between the air and water. In shallow lakes this mixing can be caused by wind.

Wetland – Generally, an area characterized by periodic inundation or saturation, hydric soils, and vegetation adapted for life in saturated soil conditions.

Year Class – An age category. For example, all of the two year old fish of a species would constitute an age class of that species.

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